Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the matter of	)	
Service Rules for the 698-746, 747-762, and 777-792 MHz Bands	)	WT Docket No. 06-150
Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band	)	PS Docket No. 06-229
Implementation of the Commercial Spectrum Enhancement Act and Modernization of the Commission's Competitive Bidding Rules and Procedures	)	WT Docket No. 05-211
Development of Operational, Technical, and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through 2010	)	WT Docket No. 96-86

COMMENTS OF

THE *AD HOC* PUBLIC INTEREST SPECTRUM COALITION

CONSUMER FEDERATION OF AMERICA
CONSUMERS UNION
EDUCAUSE
FREE PRESS
MEDIA ACCESS PROJECT
NEW AMERICA FOUNDATION
PUBLIC KNOWLEDGE
U.S. PUBLIC INTEREST RESEARCH GROUP

May 23, 2007

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SUMMARY

The *Ad Hoc* Public Interest Spectrum Coalition (PISC) applauds the Commission for including issues raised by PISC in the initial comment period.

The United States continues to fall further behind the rest of the world in broadband Internet access – our markets lack the competition necessary to serve consumers with lower prices, faster speeds and universal access. Even as the broadband market has further consolidated – leaving 96% of the market in the hands of two technologies – our policy framework has only served to diminish opportunities for competition. The auction of the 700 MHz spectrum creates a new possibility for competitive broadband provision. It is imperative that we learn the lessons of the wireline market and make the appropriate policy corrections in the launch of the most promising wireless broadband markets.

The Commission simply cannot choose to let current market conditions and participants control the outcome of the upcoming auctions. To date, existing wireless broadband providers do not offer a useful "third pipe" for American consumers. Perhaps most importantly, this market for broadband capable mobile devices is dominated by the same incumbent firms that control the wireline broadband market. These incumbents make clear that they have no intention of offering broadband with the freedom to attach any device and run any application.

To foster real wireless broadband – the fast, ubiquitous, and dynamic third pipe everyone agrees our country desperately needs – PISC recommends that the Commission take the following steps both to ensure that new spectrum is offered on an open and nondiscriminatory basis and to bring in new entrants interested in challenging the current cozy wireless oligopoly and broadband duopoly:

1. *Anonymous Bidding*: Anonymous bidding prevents bidders from using signaling and blocking techniques during the auction to deter new entrants from participating. Anonymous bidding will both maximize the likelihood of new entrants and better ensure an appropriate return to the public for the use of valuable public licenses.

2. *Exclusion of Incumbents or New Entrant Credits*: Exclusion of existing incumbents remains the simplest way to create a class of new entrants able to compete with existing providers. Alternatively, a "new entrant credit" can make it possible for new entrants to compete against deep-pocketed incumbent rivals. While this approach does not have the same certainty as a ban on incumbent participation, it does have several positive aspects to recommend it.

3. *Band Plan Issues*: The Commission should adopt band plans that facilitate creation of national providers to achieve necessary economies of scale, while still protecting the public safety issues raised by supporters of the Band Optimization Plan (BOP). Accordingly, if the Commission adopts the proposed BOP alternative, the Commission should adopt the first additional proposal, *FNPRM* at ¶ 200, which would maximize the

number of REAG licenses in the Upper 700 MHz auction while permitting resolution of the Canadian Border Area issue. If the Commission does not adopt the BOP alternative, it should adopt the first proposal. *FNPRM* at ¶ 190.

4. *Build-Out Requirements*: Licensees should be subject to a "use or lose" license condition that will allow residents of unbuilt areas to use unlicensed devices. At the same time, Commission should allow new entrants to demonstrate that failure to meet the service requirements result from genuine difficulties rather than from an intent to warehouse spectrum or leave rural areas unserved.

5. *Designated Entities (DEs)*: The Commission should grant the Council Tree/MMTC *Petition for Reconsideration* and should set rules limiting the relationships between DEs and large wireless incumbents as proposed in the *Further Notice* in that proceeding.

6. *Two-sided Auction*: A two-sided auction violates the plain language of the statute, which requires the Commission to deposit all revenues from spectrum auctions (less certain administrative expenses) into the U.S. Treasury.

7. *Open Access*: The 700 MHz auctions will not give birth to the much anticipated third pipe if the licenses are auctioned to the very same vertically integrated telephone and cable incumbents that dominate the wireline market. At least 30 MHz of spectrum licenses should be conditioned on the licensees' obligation to make wholesale service available to any provider. This will guarantee that new entrants have the opportunity to enter the market in competition with incumbent providers.

8. *Net Neutrality and Carterfone*: All the licensees of the 60 MHz spectrum must be obligated to carry all Internet and voice traffic without privilege, degradation, or preference, and they must permit consumers to use any non-interfering equipment.

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COMMENTS OF
THE *AD HOC* PUBLIC INTEREST SPECTRUM COALITION

The *Ad Hoc* Public Interest Spectrum Coalition (PISC)[1] submits these comments in response to the *Further Notice* in the above docketed proceedings. PISC applauds the Federal Communications Commission (FCC or Commission) for including issues raised by PISC in response to the initial notice. The Commission's inclusion of these proposals permits greater development of the record on how the 700 MHz Auction will further Congress' goals of enhancing broadband competition, stimulating broad deployment of wireless services, increasing

[1] For purposes of these proceedings, PISC includes Consumer Federation of America, Consumers Union, EDUCAUSE, Free Press, Media Access Project, New America Foundation, Public Knowledge, and U.S. Public Interest Research Group.

innovation in both technology and service offerings in the wireless space, and ensuring that these advanced communications services become widely available to ***all*** Americans.

INTRODUCTION

To paraphrase the old cliché, "everyone talks about wanting broadband competition, but no one does anything about it." The United States continues to fall further behind the rest of the world in broadband Internet access – our markets lack the competition necessary to serve consumers with lower prices, faster speeds and universal access. Even as the broadband market has further consolidated – leaving 96% of the market in the hands of two technologies[2] – our policy framework has only served to diminish opportunities for competition. Meanwhile, Americans pay more money for a lower quality of service than a dozen other nations. Far too many Americans remain stuck with dial-up Internet access or no Internet access at all. While 10% of Americans lack access to any broadband provider, at least 40% of U.S. zip codes have no more than one provider and, partly as a result, broadband prices per unit of bandwidth (mbps) are far more expensive than other leading nations (10 times more than France, 30 times more than South Korea, 40 times more than Japan).[3] Americans can only hope to have what other nations enjoy: a selection of truly high-speed, competitively-priced broadband providers in every local market.

The primary difference between our broadband failures and international broadband

[2] Satellite accounts for less than one-half of 1 percent (0.5%) of all advanced service residential broadband connections. Mobile wireless accounts for 2.5 percent of all advanced service residential broadband connections. Fixed wireless comprises approximately one-half of 1 percent (0.5%). *See* "High-Speed Services for Internet Access: Status as of June 30, 2006", Federal Communications Commission, Industry Analysis and Technology Division Wireline Competition Bureau, January 2007.
[3] Ben Scott, "Communications, Broadband and Competitiveness: How Does the U.S. Measure Up?", Testimony before the U.S. Senate Committee on Commerce, Science and Transportation (April 24, 2007).

successes comes down to policy choices. For instance, countries with the open access policies of local-loop unbundling, line-sharing, and bitstream access have significantly higher DSL penetration levels than countries without these policies.[4] The United States wireline broadband market has been stripped of its open access requirements, and there is little opportunity for competitive providers to compete with the large incumbents. In contrast, open access broadband policies in the rest of the world have led other countries to much higher levels of market competition, which in turn has resulted in lower prices, better service, and higher overall adoption rates.

The auction of the 700 MHz spectrum creates a new possibility for competitive broadband provision. It is imperative that we learn the lessons of the wireline market and make the appropriate policy corrections in the launch of the most promising wireless broadband markets.

The Commission simply cannot choose to let current market conditions and participants control the outcome of the upcoming auctions. To date, existing wireless broadband providers do not offer a useful "third pipe" for American consumers. Today's wireless broadband services are designed to be purchased *in addition to,* not as a substitute for, a wireline residential broadband connection.[5] Of all the advanced service lines (200 kbps in both directions) counted by the FCC, only 3.8% are mobile wireless, and only 2.5% of residential advanced service lines

[4] *See* S. Derek Turner, *Broadband Reality Check II*, August 2006, available at http://www.freepress.net/docs/bbrc2-final.pdf. (hereinafter "Broadband Reality Check II").

[5] Ninety percent of mobile wireless broadband connections are used by businesses, not consumers. And almost 85 percent of mobile wireless lines exceed 200 kilobits per second in only *one* direction. The market share for these alternatives to the DSL and cable modem models actually decreased from 2000 to 2005. *See Broadband Reality Check II*.

are mobile wireless.[6]

Perhaps most importantly, this market for broadband capable mobile devices is dominated by the same incumbent firms that control the wireline broadband market. These incumbents have little incentive to develop wireless broadband services on an open platform that competes with their existing wireline offerings. In fact, the statements by wireless incumbents in response to the *Skype Petition*[7] and elsewhere make clear that they have no intention of offering broadband with the freedom to attach any device and run any application. Cable operators, touted as "new entrants" after the strong showing by SpectrumCo in the Advanced Wireless Services (AWS) auction, have likewise made it clear that they have no intention of providing an open and dynamic broadband experience via wireless. At the recent NCTA Cable Show, cable executives explained that they intended to roll out "simple" wireless offerings and that, in the words of Cox's Vice President for wireless services, cable operators see wireless as "an extension of the home."[8]

This is neither the presence of nor the recipe for broadband competition. It is clear that a substantial change in the marketplace is required if a wireless third pipe – a substitutable

[6] Much has been made of the FCC's recent broadband data showing the mobile wireless broadband connections have dramatically increased. Indeed, around 60% of the new residential lines counted in the FCC's most recent report were wireless connections. However, this is highly misleading as a measure of whether wireless broadband is now competing directly with the dominant wireline technologies, DSL and cable modem. For the most part, the new wireless lines are broadband capable cellular phones or other handheld devices. These connections are at least twice the price of a wireline connection and most operate at only a fraction of the speed. Tellingly, virtually no residential consumers of broadband have cancelled their subscriptions to wireline connections to substitute the use of a broadband capable cellular telephone. These devices are *not* substitutes or competitive alternatives to DSL and cable modem.

[7] *See, e.g.,* Skype Communications S.A.R.L., Petition to Confirm a Consumer's Right to Use Internet Communications Software and Attach Devices to Wireless Networks, RM-11361 (filed Feb. 20, 2007) (hereinafter referred to as the "Skype Petition").

[8] Josh Wein, "Cable Operators Keeping Wireless Device Offerings Limited, Simple," *Communications Daily* (May 10, 2007).

competitor to DSL and cable modem service – is to be created. The 700 MHz auction offers that opportunity if we make the policy choices necessary to seize it.

To foster real wireless broadband – the fast, ubiquitous, and dynamic third pipe everyone agrees our country desperately needs – PISC recommends that the Commission take the following steps both to ensure that new spectrum is offered on an open and nondiscriminatory basis and to bring in new entrants interested in challenging the current cozy wireless oligopoly and broadband duopoly:

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Certainly the 700 MHz Auction provides only a starting place to re-energize broadband as a driver of economic progress and protect broadband as a vital tool of civic engagement. Adopting the PISC proposals for this auction does not change the basic need to ensure openness and competition among the existing dominant wireless and wireline providers. At the same time, however, the Commission should not squander this chance merely because it may take much-needed action in other proceedings at some indeterminate point in the future.

I. Because Existing Incumbents Have Already Demonstrated Their Preference for Closed and Discriminatory Networks, the Commission Must Structure the Auction to Encourage New Entrants to Participate in the Auction and to Create Genuine Competition to the Incumbents.

The Commission must structure the auction so as to maximize the likelihood that new broadband providers willing to offer competitive services via an open network will win sufficient spectrum to make this possible. While winners of the 700 MHz auction will no doubt eventually offer some sort of Internet access service or 4G wireless services via the spectrum, it will not be the open, edge-controlled third pipe that has become centerpiece of Commission broadband policy unless the Commission takes specific actions to promote such a result. The evidence clearly shows that an auction like the AWS auction, in which the dominant incumbents won virtually all the significant licenses, will result in a carefully managed wireless "walled garden." Further, given the history of incumbent warehousing of spectrum, it remains unclear how long Americans will have to wait until even a crippled third pipe becomes available.

A. By Their Own Admission, Existing Incumbents Have No Interest In Building An Open Third Pipe.

Existing incumbents have challenged the need for rules that will facilitate new entry, arguing that that doing so would "disenfranchise [the very carriers] that hold the best promise of providing the third pipe that PISC supports.[9] By their own words, however, incumbents have made clear that they have no intention of building a wireless broadband service that provides the same openness and user experience enjoyed by wireline broadband subscribers and endorsed by the Commission through its *Broadband Policy Statement.*[10] The recent comments filed in the *Skype Petition* by the incumbent wireless carriers intending to bid in the 700 MHz auction make clear the sort of wireless broadband Internet Americans can expect if the Commission fails to restructure the service rules and auction rules in the manner proposed by PISC. These carriers do not deny that they routinely choke bandwidth to users, cripple features, and control the user experience, as described by Professor Wu and others.[11] Rather, the dominant wireless carriers

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[9] *See* Ex Parte Letter from Carl Northrop on behalf of MetroPCS, submitted April 17, 2007, in WT Docket 06-150, PS Docket No. 06-229, WT Docket No. 96-86, p.2.

[10] Appropriate Framework for Broadband Access to the Internet over Wireline Facilities, *Policy Statement*, FCC No, 05-151 (2005), available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-05-151A1.pdf.

[11] *See* Tim Wu, Wireless Net Neutrality: Cellular *Carterfone* and Consumer Choice in Mobile Broadband, Feb. 2007, available at http://www.newamerica.net/files/WorkingPaper17_WirelessNetNeutrality_Wu.pdf.

assert that because the wireless space enjoys “fierce competition,” the Commission has no business regulating providers even to enforce the existing *Broadband Policy Statement* adopted by the Commission in 2005.[12]

For example, AT&T speaks of the “fiercely competitive” wireless market in which “the absence of market failure” demonstrates the value of permitting it (and other carriers) to limit services in a manner utterly contrary to the nature of the Internet today.[13] Likewise, T-Mobile insists that “Skype’s proposal is unnecessary in light of the highly competitive nature of the wireless marketplace,”[14] and that application of the Commission’s *Broadband Policy Statement* to wireless services would deprive customers of quality of service and differentiated offerings.[15]

Leaving aside for the moment the unjustified assertion that the current, federally protected oligopoly constitutes a “free market,” let alone a “fiercely competitive” one, the Commission should consider the implication of these comments, filed by the most likely winners of an auction held under the same rules as the AWS auction, *i.e.*, ‘The crippled, controlled proprietary wireless Internet of today will become the crippled, controlled proprietary third pipe of tomorrow.’

Indeed, these same carriers that insist in this proceeding that they aspire to become the third pipe, assert that it is physically impossible to provide the same open and dynamic Internet experience enjoyed by wireline broadband subscribers over wireless systems. According to MetroPCS, spectrum resources are “scarce” and MetroPCS must “carefully manage the use of its

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[12] Appropriate Framework for Broadband Access to the Internet over Wireline Facilities, *Policy Statement*, FCC No, 05-151 (2005), *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-05-151A1.pdf.
[13] Comments of AT&T Inc. Opposing Skype Communication’s Petition, RM-11361, at 13 (filed April 30, 2007).
[14] Opposition of T-Mobile, RM-11361, at 40 (filed April 30, 2007).
[15] *Id.* at 37.

network to assure there is sufficient capacity to meet subscriber demand."[16] Verizon Wireless describes, at considerable length, how permitting the same openness on wireless networks as permitted on wireline networks would significantly degrade the operation of their wireless network and jeopardize important public safety applications.[17]

This is not to say that these companies do not compete against each other for wireless customers. PISC acknowledge that companies such as MetroPCS fully intend to offer services that compete with Verizon Wireless and AT&T – of their own choosing, in their own time, and as makes business sense to them. If the Commission intends for the 700 MHz auction to provide the public with simply "more of the same," then the Commission should, indeed, do nothing and allow the 700 MHz auction to mirror the results of the AWS Auction. But if the Commission intends to foster dynamic broadband competition, then it should take the existing wireless providers at their word and look elsewhere for licensees that will build an open broadband network with returned broadcast spectrum.

The actions by SpectrumCo following the AWS market underscore the nature of the choice before the Commission. Although hailed by some as "new entrants" in the wireless market, SpectrumCo and other incumbent cable operators have proven even less interested in offering competitive wireless networks than existing wireless operators. To the extent cable operators have clarified their wireless plans, they involve integrating these offerings with existing cable video and broadband, not introducing robust competition even into the existing wireless voice market, let alone the broadband market.[18] To the extent that wireline broadband

[16] Comments of MetroPCS, RM-11361 at 11 (filed April 30, 2007).
[17] Comments of Verizon Wireless, RM-11361 at 29-47 (filed April 30, 2007).
[18] *See, e.g.,* Eric Savitz, "Report: Comcast Exec Denies Plans to Buy Sprint; Launching Wireless Trial," Tech

offers clues to cable wireless offerings, this history offers little cause for optimism that cable wireless will become an open third pipe. Cable operators rejected requests to open their wireline broadband networks to competitive Internet Service Providers (ISPs) and have steadfastly opposed policies designed to ensure the nondiscriminatory provision of applications and services over their broadband networks.[19] It is logical to expect that, on the wireless side, cable operators have little interest in providing service over an open platform.

The Commission has made a vibrant third pipe the foundation of its deregulatory policies and the keystone of its efforts to promote broadband. Its actions and assumptions rest on emergence of a third pipe provider that will force the wireline duopoly to remain open, edge driven, and competitive. Given the public positions of the existing wireless and wireline incumbents, the Commission must recognize that this open third pipe will not happen if the incumbents win the majority of licenses.

B. The History of Incumbent Warehousing Underscores The Need For New Pro-Competitive Auction Rules and Service Rules.

As demonstrated by the study submitted on behalf of M2Z by Dr. Simon Wilkie[20] the existing incumbents use the auction process to prevent new entry by denying new entrants needed spectrum access. While using the auction process to block potential rivals, the

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Trader Daily, available at http://blogs.barrons.com/techtraderdaily/2006/11/20/report-comcast-exec-denies-plans-to-buy-sprint-launching-wireless-trial/ (November 20, 2006) (last visited May 21, 2007) (Comcast will not "shell out big bucks to build out a wireless network."); Mike Farrell, "Alchin: Comcast Won't Be A Cellular Competitor," Multichannel News (September 12, 2006) (viewed on May 22, 2006 at http://www.multichannel.com/article/CA6371166.html?display=Breaking+News).

[19] *See* Louis Trager, "Cable Seeks Web-Style Interactive Glitz While Keeping Walled Garden," Communications Daily at 11 (May 14, 2007).

[20] Simon Wilkie, *Spectrum Auctions Are Not a Panacea: Theory and Evidence of Anti-Competitive and Rent-Seeking Behavior in FCC Rulemaking and Auction Design,* M2Z Networks, March 26, 2007, http://www.m2znetworks.com/resource-center/ (at entry for March 26, 2007).

incumbents then fail to build networks and use the spectrum – either because they do not wish to undermine the existing spectrum scarcity or because they have no real plans for deployment and sought licenses solely to keep them from rivals.

The recent AWS auction, continuously applauded by SpectrumCo and wireless incumbents as the model for the Commission to follow here, provides a useful case study. SpectrumCo bid intensely for the largest licenses (the REAG licenses) while its chief video rival, DBS Wireless, remained in the auction. When DBS Wireless switched its strategy and bid on smaller licenses, SpectrumCo pursued and bid for the same licenses. After DBS Wireless dropped out of the bidding, however, SpectrumCo's strategy changed remarkably. Suddenly, SpectrumCo lost interest in bidding aggressively for specific licenses and became a "bargain hunter" acquiring licenses as cheaply as possible.[21]

As SpectrumCo itself explained following conclusion of the auction, SpectrumCo had no specific plans for wireless deployment and no intention of either becoming a wireless cell phone provider or even building a comprehensive national network.[22] Rather, SpectrumCo had taken advantage of an opportunity "to obtain greater flexibility in developing options" for undefined wireless services sometime in the future.[23] As SpectrumCo explained:

> There is a finite amount of available spectrum and it is rare that this amount of national spectrum becomes available at auction. The consortium team acquired licenses at attractive prices. The spectrum licenses were won for an average price of $0.45 per megahertz-pop, which was the lowest average price paid by all the major bidders in the auction.[24]

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[21] Gregory Rose, *How Incumbents Blocked New Entrants in the Aws-1 Auction: Lessons for the Future* (April 20, 2007), at 37-38.
[22] "Cable Consortium Acquires Spectrum Licenses Covering National Footprint" Comcast Corporation Press Release, Oct. 5, 2006., available at: http://www.cmcsk.com/phoenix.zhtml?c=118591&p=irol-newsArticle&ID=912578&highlight (last viewed May 22, 2007).
[23] *Id.*
[24] *Id.*

While Comcast's shareholders may applaud the ability of the company to acquire "rare" licenses for significant amounts of our "national spectrum" at bargain prices, this result hardly serves the public interest or brings the hoped for third pipe any closer to reality. Nevertheless, unless the Commission takes active steps to prevent existing incumbents from blocking rivals and warehousing licenses, the public can expect a similar result.

II. The Commission Can Further Promote Competition By Obligating Licensees of 30 MHz to Abide by Open Access Conditions and By Obligating All 700 MHz Broadband Licensees to Abide By Net Neutrality.

PISC recommends two complementary approaches to facilitating a re-emergence of broadband competition necessary to recapture the standing of the United States as a leader in broadband and technological innovation. First, PISC expands on the previously submitted proposals by recommending that 30 MHz of spectrum be allocated on an "open access" model. Second, PISC recommends that the basic consumer protection policies of "Carterfone" and "network neutrality" should apply to all 60 MHz auctioned in the band.

PISC continues to support the Frontline "open access" proposal based on the service rules proposed (and supports applying the open access requirements to an additional 20 MHz). In response to the *FNPRM*, PISC believes that the wholesale condition on the "E Block" remains critical to ensuring that the Frontline proposal serves the public interest.

These proposals will stimulate innovation and competition in the related markets of equipment, wireless services, and broadband services by making quality spectrum available to providers at reasonable cost. In this regard, the Commission should consider that the last time it distributed spectrum below 1 GHz for mobile services, it gave free licenses to the incumbent

ILECs on a theory that this would ensure deployment of wireless services. That foundational advantage still reverberates to this day. It is no coincidence that the two largest wireless networks, each boasting the best quality of service, are the two that incorporate those initial and substantial grants of spectrum with the exceptional propagation characteristics of the one-time upper UHF-TV band. Making 30 MHz of spectrum below 1 GHz available to all would-be providers will ensure that competition in the world of wireless broadband will begin on a more equal footing.

A. The 700 MHz Auction Represents the Best Chance to Create A Viable Third Pipe for Consumer Broadband Competition.

The quest for the so-called third pipe as a panacea to our lagging national broadband market and as a reason to forbear from needed regulation to foster competition and protect consumers has become the central platform of the Commission's broadband strategy. Under this theory, the emergence of a new national competitor or platform would provide enough competitive pressure to avoid any need to regulate anything classified as an "information service." Yet despite this centrality, the Commission has done little to facilitate the emergence of a third pipe beyond extending the deregulatory framework adopted in 2005 and hoping for the best.[25]

PISC remains exceedingly skeptical that the emergence of one more competitor (or even one more competitive platform) will accomplish what the Commission accomplished under its previous rules providing open access to wireline networks by competitors and a prohibition

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[25] *See, e.g.,* Appropriate Regulatory Treatment for Broadband Access to the Internet over Wireless Networks, *Declaratory Ruling,* FCC No. 07-30 (2007). *See also* United Power Line Council's Petition for Declaratory Ruling Regarding the Classification of Broadband over Power Line Internet Access Service as an Information Service, *Memorandum Opinion and Order*, 21 FCC Rcd. 13 (2006).

against discrimination based on content or origin ("network neutrality"). Indeed, broad adoption of the Commission's previous wireline open access regulations by countries that had previously lagged behind us in international rankings has allowed these countries to leapfrog ahead of us by creating real competition for broadband services.[26] PISC therefore does not suggest that creation of a third pipe in this band removes the need for broader application of network neutrality and open access rules. Nevertheless, because the Commission has remained fixated on creation of a third pipe as the focus of our national broadband strategy – and because enhanced broadband competition and deployment would be so beneficial to consumers and the economy – PISC urges the Commission to make the most of the unique opportunity presented by the 700 MHz to affirmatively facilitate creation of new broadband competitors.

Certainly, to the extent the Commission intends to promote a competitive third broadband platform, the spectrum up for auction in this proceeding is uniquely suited to become the third pipe alternative. Because of the favorable propagation characteristics of this spectrum, signals can relatively easily penetrate dense foliage, reach the interior spaces of buildings, and cost-effectively cover large, less densely populated areas. In other words, it can be used to deliver affordable wireless broadband services to areas currently underserved by incumbent broadband providers using either wired or wireless technologies. The 700 MHz band could provide Internet access that is faster and cheaper than existing wireless services, combined with a mobility that provides a significant advantage over existing wireline services. Rather than serving a "niche" market, services in the 700 MHz band could become many consumers' primary source of high speed Internet access and low-cost voice service.

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[26] *See* S. Derek Turner, *Broadband Reality Check II*, August 2006, available at http://www.freepress.net/docs/bbrc2-final.pdf.

Thus, the auction of the 700 MHz band represents the best opportunity in the foreseeable future to bring a legitimate third pipe into the U.S. broadband market. But it is by no means a certainty that this result will be achieved. Previous auctions, such as the AWS auction, resulted in a set of dominant bids by the incumbent wireline providers of broadband services – in particular AT&T and Verizon. The products provided by these companies (such as mobile video) are welcomed by consumers, but these firms are unlikely to bring to the market a truly substitutable product to compete with DSL and cable modem, the technologies that currently hold 96% of the residential broadband market. They have not done so with their current wireless broadband offerings, and they have an incentive *not* to cannibalize their own wireline broadband product market. We should not expect them to do so. Vertically integrated incumbents will have no incentive to open their networks and will continue to offer packages of services that seek to leverage their market power across adjacent markets. Any policy that opens the door to incumbent dominance of 700 MHz in anticipation of increased broadband competition is irrational.

Finding the shortest route to operationalize a bona fide third pipe has long been the elusive goal of US broadband policy. It is imperative that the service rules in the 700 MHz band guarantee the entrance of new competitors into the residential broadband market. No policy priority could be more urgent to the nation's broadband future. Maximizing competition in wireless broadband services must be the first goal of this auction.

B. Open Access As Network Architecture: A Return To A Proven and Successful Model.

The open access model has a proven track record for promoting competition and ease of implementation. Until the Commission abandoned this model on a theory that deregulation was the only means to spur deployment of fiber to the home, the application of the open access model under the 1996 Telecommunications Act and the *Computer Proceedings* created a competitive environment in which more than 6,000 independent ISPs offered subscribers a wealth of differentiated offerings at low prices, while preventing any ISP from "owning" subscribers or extorting payments from content or service providers. The widespread adoption of open access in other countries, at the very time that the FCC abandoned open access at the urging of cable and telephone incumbents, has had similar salutary effects. Nations that once envied our communications infrastructure now enjoy speeds, prices, and services unobtainable by consumers in the United States.

The 700 MHz auction allows the Commission to return to this highly successful model. The arguments of the past – that carriers would not build infrastructure to share with rivals, that carriers invested under a set of expectations that did not include sharing, and so forth – do not apply. One bidder has volunteered to accept an open access condition willingly. Given the clamor for spectrum-based services and the unwillingness of existing wireless networks to respond, the Commission can expect other bidders once it sets open access service rules.

As the attached Engineering Assessment from Columbia Telecommunications Corp. (CTC) explains, implementation of true open access in the wireless world requires no complex arrangements or new technology.[27] To the contrary, the implementation of open access in a manner similar to the successful implementation of open access in the wireline world has a simple and straightforward solution: Don't sell capacity, sell interconnection.

Any wireless cellular network supporting mobile, nomadic, or fixed customers has a basic set of standard elements. End users transmit from customer premise devices[28] (CPE) to communications towers. Towers interconnect with a "backhaul network," which in turn carries traffic to the providers' core network and through gateways to other relevant networks. Return traffic to users is routed the same way, but in reverse, passing out of other networks via gateways to the operators' core network through gateways to the backhaul network, then routed to the proper tower, and finally back to the device. While the software and equipment that accomplishes these tasks is complex, the actual architecture is fairly simple and straightforward.

A service rule that requires the licensee to sell interconnection ***at a gateway***, either between the tower and the backhaul network or between the backhaul network and core network (or, if necessary, between the licensee's core network and the broader "cloud"), achieves an open access regime that permits any number of competitors without creating a problem of apportioning bandwidth. From a customer perspective, the network is seamless. Whatever capacity exists in the network as a whole exists for every customer in exactly the same fashion as if only one provider served all customers, because the service providers do not compete with each other for spectrum between the device and the tower. The routing of signals takes place

[27] *See*, Appendix A: An Engineering Assessment of Select Technical Issues Raised in the 700 MHz Proceeding, Columbia Telecommunications Corp. (hereinafter CTC Engineering Study).
[28] CPE is used here to include mobile and nomadic devices as well as that located in a customers' home or office.

behind the tower, eliminating the impact of open access on the availability of spectrum between the customer and the tower.

As CTC explains, open access does not create new problems of congestion or apportionment of spectrum. To the contrary, open access ***improves*** spectrum efficiency.[29] A properly designed open access system will permit multiple retail service providers to share spectrum, thereby maximizing bandwidth speeds. In other words, the transmission speed will increase as the amount of shared spectrum made available under an open access regime increases.

The added advantage of this proposed architecture is that it allows numerous providers to offer discrete and differentiated services while still using the spectrum to its maximum potential. Provider A may offer fixed broadband service, while Provider B offers mobile video services, and Provider C offers a combination of fixed, nomadic and mobile "triple play."

CTC explains how this would work in the context of this architecture:

> The wireless infrastructure operator provides transmission services at wholesale rates to the various service providers. Service level agreements between the network operator and the service provider would dictate service attributes such as the number of users support, maximum bandwidth supported, and quality of service. The wireless service providers could offer a bundle of services including telephony, video, and Internet access.[30]

CTC makes the important point that an open access regime is a more efficient use of spectrum than individually-assigned channels. The study notes that a single 10 MHz channel can

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[29] Columbia Telecommunications Corp., *An Engineering Assessment of Select Technical Issues Raised in the 700 MHz Proceeding* 14 (2007) (CTC "Engineering Report").
[30] Id. at 7.

permit speeds of 10 mbps, comparable to today's transmission speeds, but unlikely to compare to the transmission speeds offered by cable and telephone providers in the future.[31]

For this reason, PISC respectfully requests that the Commission, in the final order adopting service rules for the 60 MHz of spectrum to be auctioned in the 700 MHz band, designate at least three license blocks (or 30 MHz, whichever is greater) as "open access" blocks. In these spectrum blocks, all licensees should be required, as a condition of their respective licenses, to construct and operate wireless broadband systems that comply with open access principles. This will allow multiple retail service providers to offer service across all 30 MHz of spectrum, even if the licenses are awarded to three different network owners. The open access licenses, as well as the licenses to be auctioned for the remaining 700 MHz spectrum, would be subject to the build-out requirements and other service rules that the Commission adopts in the current rulemaking.

In this regard, PISC reaffirms its basic support for the Frontline proposal, but ***only*** if the E Block has the proposed mandatory "wholesale" condition. While PISC believes that open access should mean what it means in the wireline world – interconnection of providers at the relevant and useful point in the network – PISC remains open to other business models in the E Block that both preserve the neutral, wholesale nature of the license and contain mechanisms that prevent any single customer or a small subset of customers from monopolizing the available

[31] "If the FCC allocates 5 or 5.5 MHz paired channels of spectrum, the provider will be able to offer 10 Mbps per customer – speeds that are technically competitive in today's environment, but likely not that of 10 years from now. Only allocations of 10 MHz or more paired channels can effectively provide 20 Mbps or more – speeds that will be able to compete with DSL and cable modem service in the future years when the 700 MHz service actually becomes available, assuming the spectral efficiency of existing and foreseen technologies." CTC Engineering Study, p. 9.

wholesale spectrum. The recent proposal by Google for "real time auctions" of spectrum capacity, properly implemented, could potentially be such a method.[32]

C. Open Access Policies Will Promote Competitive Entry by Wireless Service Providers and Internet Service Providers.

The recent history of the American and the global broadband market should serve as a guide to inform the most appropriate policies for enhancing competition. Two policies stand out as exemplary in promoting broadband expansion, price discipline, and enhanced quality of service: unlicensed spectrum and open access to the transmission layer of networks. The explosion of innovation in the unlicensed Wi-Fi bands has been the most important development in the broadband market in recent years. Yet the opportunity to apply a policy of unlicensed innovation to the 700 MHz band has been precluded by Congress. To realize the public interest benefits that might be made available as a result of the digital transition require far more aggressive policy proposals than we are submitting here.

This leaves us with open access policy. This is the principle that led the United States to world leadership in communications and this is very likely the only principle that can restore the U.S. to its leadership position. Ironically, the open access system designed in the U.S. in the 1990s has been adopted in the European market even as we have abandoned it. The result in Europe has been the expansion of broadband competition, the enhancement of speeds, and the decline of prices. Many urban markets enjoy several wireline providers offering competing services on the same facilities. It is a consumer paradise by comparison to the U.S. Here at

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[32] Ex Parte Letter of Google, Inc.., submitted May 21, 2007 in WC Docket No. 06-150; WC Docket No. 06-129; PS Docket No. 06-229; WT Docket No. 96-86 (regarding Service Rules for the 690-746,747-762, and 777-792 MHz Bands).

home, we have witnessed a relative stagnation in broadband development. Our markets are dominated by two wireline technologies with little to no competition. It is an issue that begs for attention in the wireline policy arena. Since an opportunity for the broader application of open access principles to communications networks is unavailable or unrealized, it is imperative that the Commission seize the opportunity to apply it to at least some portion of the 700 MHz band.

Beyond that, the Commission should apply competition policy to the transmission layer of the 700 MHz networks by requiring open access as a condition of the license. This is the competition policy that has proven most successful in advantaging the broadband markets of the world's leaders. This is the competition policy that will ensure that multiple providers of competitive services will go head-to-head to win business from consumers. This is the competition policy that the public deserves to see applied to the public airwaves to maximize social and economic value.

PISC would prefer to see all of the spectrum blocks up for auction in the 700 MHz band be made available on an open access basis. However, PISC recognizes that competing interests for this valuable spectrum will foreclose that option.

Imposing open access conditions on some portion of the 700 MHz band will provide a check on any other wireline carriers who are pushing for discriminatory networks. Although not as effective as a requirement that all communications networks be operated in a non-discriminatory manner, the nationwide open wireless network would provide a safety valve. Should the incumbents go too far in discrimination (and we believe that they have every incentive to do so), the nationwide open wireless network would provide a refuge for consumers and ISPs who are being abused. Further, the open access sector of the 700 MHz band would produce the kind of competition that drives innovation, lowers prices, and enhances services.

We believe that the Commission would disserve the interests of consumers generally if it were to follow the same course that it has taken in recent auctions of CMRS spectrum, relying largely on market forces to deliver services that consumers want and need in a timely and affordable fashion. Likewise, we believe that there is no assurance that reliance on a single "open access" licensee would suffice to meet the Commission's obligation to ensure the availability of rapid and efficient broadband communications to all Americans.

D. Net Neutrality Service Rules are Necessary to Preserve Competition among Internet-based Applications, Services and Equipment.

The consumers' rights to choose equipment, applications and services that best meet their individual needs have not been well served by the market. Consumers' ability to access lawful content anywhere on the Internet is in jeopardy as incumbent broadband Internet service providers (wireless broadband providers, as well as cable and telephone companies) take steps to extend their control into adjacent markets for content in violation of established principles of consumer choice and openness. They have proposed to prioritize, or give preference to, certain Internet traffic over other traffic.[33] Wireless service providers dictate the types of equipment consumers may use and the features embedded in that equipment. Furthermore, equipment

[33] *See* "Executive Wants to Charge for Web Speed; Some Say Small Firms Could Be Shut Out of Market Championed by BellSouth Officer," By Jonathan Krim, Washington Post: Dec. 1, 2005. ("A senior telecommunications executive said yesterday that Internet service providers should be allowed to strike deals to give certain Web sites or services priority in reaching computer users, a controversial system that would significantly change how the Internet operates.").

manufacturers are increasingly marketing network equipment that makes it easier for network operators to identify, screen, prioritize, block, or impair certain types of traffic.[34]

In short, wireline and wireless broadband Internet access providers are increasingly controlling the user's Internet experience. If left unchecked, the consequences to the Internet, and to consumers, could be disastrous. Unless action is taken now to extend fundamental principles of consumer choice and openness to wireless services, consumers will lose the transforming benefits that the Internet has made possible over the past decade. Implementing non-discrimination requirements for wireless broadband will help ensure that consumers have open and unfettered access to the Internet without gatekeeper control.

Even if the 700 MHz licenses are won by new entrants in the marketplace, there is no reason to believe that they will treat Internet traffic and equipment in a non-discriminatory manner. The experience in the existing market for cellular and PCS operators demonstrates that, even when there are multiple providers in a market, network providers are placing limits on the ability of consumers to use the devices and applications of their choice. The recent Working Paper issued by the New America Foundation documented how the incumbent mobile broadband providers typically impose five kinds of restrictions on consumers that violate the principle of consumer choice and openness:

1. Refusing to allow consumers to attach their own devices to the mobile services;
2. Requiring equipment manufacturers to omit or cripple many consumer-friendly features of the devices authorized by the services provider;
3. Prohibiting access to or full use of many Internet-based applications and content

[34] *See* "Good Fences Make Bad Broadband," a Public Knowledge White Paper, by John Windhausen, Jr., February 6, 2006, available at http://www.publicknowledge.org/content/papers/pk-net-neutrality-whitep-20060206.

services, including terms of use that preclude downloading music, video, games, and VOIP services not approved by the carrier;

4. Imposing undisclosed bandwidth limits and usage restrictions on consumers' use of their phones; and

5. Stalling the development of new applications.[35]

The study found that these practices are common among all four of the nationwide providers of mobile services. Even though there are multiple providers in the mobile services market, each of them routinely controls the equipment that customers can connect to the network and builds walls around the applications, services and content that customers can access over the Internet. If the 700 MHz auction licenses are won by brand new entrants into the mobile services marketplace, they will face no competitive pressure from existing providers to abide by the principle of openness. In fact, closing the consumer's experience appears to have become standard business practice in the mobile services marketplace – a tacit collusion aimed at dominating the adjacent markets for consumer devices, applications and paid content. Thus, there is no reason to believe that the marketplace will address the consumer's need for a neutral platform.

A simple nondiscrimination principle (or "network neutrality") should therefore be applied to all the 700 MHz licensees to ensure that they do not discriminate against independent providers of content, applications or equipment. It is entirely appropriate for the Commission to exercise its traditional authority to condition a license for exclusive use of the publicly-owned spectrum resource on obligations that promote the public interest, convenience, and necessity. Section 309(j), of the Communications Act provides for auctions to resolve conflicting

[35] *See* Tim Wu, Wireless Net Neutrality: Cellular *Carterfone* and Consumer Choice in Mobile Broadband, Feb. 2007, available at http://www.newamerica.net/files/WorkingPaper17_WirelessNetNeutrality_Wu.pdf;

applications for an available license, but it in no way diminishes the Commission's responsibility to ensure that the ultimate use of the public airwaves promotes the general public interest. Service rules predicated on Commission consumer protection policies are nothing new. Conditioning a license on a public interest obligation to ensure basic consumer choice and open network principles is, like license conditions imposing build-out requirements and technical criteria to avoid harmful interference to other licensed services, a traditional and transparent approach that gives bidders explicit notice that use of this public resource must not contradict public policy. At a minimum, we propose that the Commission make explicit in the 700 MHz auction service rules that the Commission's *Carterfone* principles and other open network principles, including those adopted in pending or future proceedings, will extend equally to wireless broadband Internet access services operating on the auctioned frequencies.

This proceeding gives the Commission the opportunity to adopt net neutrality service rules *before* the auctions are held. This timing is important. First, parties can participate in the auction with full awareness of the rules. Second, adopting net neutrality service rules at this time will ensure that the 700 MHz services and products will be designed from the start to be compatible with multiple handsets and service, application and content providers. The industry cannot make the argument at this stage that they have already made a "sunk" investment that should not disturbed. The 700 MHz band services are still in a nascent phase – every auction winner will have the opportunity to design its services and equipment to satisfy the service rules from their inception. The incorporation of these net neutrality rules into the design phase significantly reduces, if not eliminates, any possible costs of compliance.

The U.S. has a long history of ensuring the compatibility and interoperability of equipment and services. As mentioned earlier, the FCC has for decades ensured that telephone equipment would operate seamlessly with the telephone network – the so-called *Carterfone* rules. Both Congress and the FCC require television sets to be compatible with broadcast and cable television signals. The FCC's application of *Carterfone* principles to cable set-top boxes was, according to the National Cable & Telecommunications Association, "intended to spark a retail market for independent devices that can access cable's upgraded networks. Consumer adoption of CableCARDs has been steadily increasing since their introduction, with . . . more than 548 CableCARD-compatible product models designed by consumer electronics manufacturers."[36] Just recently, the FCC took steps to ensure that the newly merged AT&T would not privilege, degrade, or prioritize any Internet traffic. Furthermore, the FCC requires most telephone equipment to adhere to the rules for hearing aid compatibility (HAC).

All these requirements have been instrumental in allowing consumers to benefit from competition and a diversity of media and technology sources. For the same reasons, the FCC should establish service rules for two-way broadband services to ensure that 700 MHz licensees do not discriminate against unaffiliated applications, services, content, or equipment. Moreover, the Commission should indicate, as part of the service rules, that the licensees will also be subject to any interoperability standards later adopted to facilitate consumer choice and open networks by creating an interface comparable to the standard phone jack that derived from the *Carterfone* principles.

[36] National Cable & Telecommunications Association, *2007 Industry Overview: Competition Works, Consumers Win*, at p. 11 (Washington, D.C. 2007).

E. Open Access and Network Neutrality Further the Interests of the First Amendment and the Policies of the Communications Act.

As part of its public interest analysis, the Commission is not free to simply weigh the economic benefits to individual licensees or the conditions that will maximize auction revenue. To the contrary, "the 'public interest' standard necessarily invites reference to First Amendment principles . . . and, in particular, to the First Amendment goal of achieving 'the widest possible dissemination of information from diverse and antagonistic sources.'"[37] Indeed, the FCC has a fundamental responsibility to protect the public's "collective right to have the medium function consistently with the ends and purposes of the First Amendment."[38]

In general, discretionary licenses on the right to communicate are repugnant to the First Amendment.[39] Only because unregulated use of the electromagnetic spectrum by ***everyone*** would make impossible the effective use of the spectrum by ***anyone*** has the Supreme Court permitted the Federal Government to license spectrum.[40]

Accordingly, where licensees demonstrably use the exclusive control over the public airwaves granted by the Federal Government to act as gatekeepers, the Federal Government has not merely the authority, but the responsibility, to take remedial action.[41] The need for government intervention is even greater where licensees offer no service, but act merely to prevent others from communicating.[42]

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[37] *FCC v. National Citizens Committee for Broadcasting*, 436 U.S. 775, 795 (1978) (citations omitted).
[38] *Red Lion Broadcasting Co., Inc. v. FCC*, 395 U.S. 367, 390 (1969).
[39] *See generally Watchtower Bible & Tract Society of New York, Inc. v. Village of Stratton*, 536 U.S. 150, 161-64 (2002).
[40] *National Broadcasting Co. v. United States*, 319 U.S. 190 (1943); *Federal Radio Commission v. Nelson Bros.*, 289 U.S. 266 (1933); *In re Nextwave Personal Communications, Inc.*, 200 F.3d 43 (2d Cir. 1999).
[41] *Red Lion*, 395 U.S. at 391 (public's "paramount" First Amendment interest in use of radio "may not be Constitutionally abridged by Congress or by the FCC").
[42] *Cf.* Stuart Minor Benjamin, "The Logic of Scarcity: Idle Spectrum As First Amendment Violation," 52 Duke L.J.

As documented in Part I, existing operators most likely to win licenses absent direct action by the Commission will continue to limit the capabilities of subscribers to communicate and innovate. Imposing network neutrality on all licenses auctioned here clearly furthers the First Amendment goals of fostering both the production of speech and access to the speech of others. Similarly, auctioning 30 MHz of spectrum subject to an "open access" condition will enhance both the number of potential speakers via spectrum and the innovative nature of these communications.

In addition, making spectrum available via open access directly addresses goals of the Communications Act demonstrably unserved by recent auctions. As reported by the Center for American Progress, incumbents have won an increasing percentage of licenses over time.[43] Further, since the Commission's decision to eliminate the minority bidding credit following *Adarand v. Pena*[44], the percentage of licenses owned by minority or women-run businesses has declined precipitously as a percentage of overall license ownership.[45]

The Commission has a legal obligation to reverse these outcomes. Congress instructed the Commission to structure auctions to prevent "excessive concentration of licenses" and to "ensure" that small businesses, women-owned businesses, and minority-owned businesses "are given the opportunity to participate in the provision of spectrum based services"[46] As a general policy, The Communications Act announces a "national policy" of encouraging "diversity of

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1 (2002).

[43] Gregory F. Rose & Mark Lloyd, *The Failure of Spectrum Auctions*, Center for American Progress, May 23, 2006, http://www.americanprogress.org/issues/2006/05/b1707035.htmlhttp://www.americanprogress.org/kf/spectrum_auctions_may06.pdf at 7.

[44] 515 U.S. 200 (1995).

[45] *See* Leonard M. Baynes and C. Anthony Bush, "The Other Digital Divide: Disparity in the Auction of Wireless Telecommunications," 52 Catholic U.L.Rev. 351 (2003).

[46] 47 U.S.C. §§ 309(j)(3)(C), (4)(D).

media voices, vigorous economic competition, technological advancement, and promotion of the public interest."[47]

The open access and network neutrality rules further these statutory goals. By contrast, the current combination of auction rules and service rules has produced an excessively concentrated market that systemically excludes small businesses and minority-owned businesses from "participating in the provision of spectrum services." Given the clear statutory commands of Congress, the Commission should adopt the PISC open access and network neutrality proposals as the best means of furthering these goals.

III. The Commission Must Use the Auction Process to Promote New Entrants.

In assessing whether "incumbents" or "new entrants" benefit from changes to the bidding rules, the Commission must take a broader view than the existing CMRS market. For example, in rejecting anonymous bidding in the AWS auction, Commissioner Adelstein focused on the statements of smaller companies, such as Leap and MetroPCS, that anonymous bidding would prevent them from accumulating spectrum to grow from "Tier II" carriers to more competitive positions.[48] These carriers did, indeed, acquire new spectrum in the AWS auction – albeit at the expense of more disruptive providers targeted by incumbents.

The broader policy question for the Commission in evaluating the rules for the 700 MHz auction is not whether CMRS competitors favor changes. The question is what services does the Commission want to see as the result of the 700 MHz auction, especially in light of the unique characteristics of this band. The objection that changing the rules to facilitate broadband

[47] 47 U.S.C. §257(b).
[48] *Public Notice: Auction of Advanced Wireless Services Licenses*, 21 FCC Rcd 4562 (2006).

competition "interferes with the market" and "determines outcomes" denies a fundamental truth of wireless – the very fact that the government limits use of spectrum to a handful of licensees and decides on how to distribute these licenses already "interferes with the market" and "determines outcomes." The Commission's AWS auction rules effectively dictated the business model that would be pursued by auction winners. If the Commission does not alter the auction rules to promote new entrants, it can anticipate that the likely winners will continue to build proprietary networks along the lines offered today and that broadband competition will remain unchanged. On the other hand, if the Commission genuinely expects to see wireless broadband emerge as a competitive force that can challenge the existing wireline duopoly, then the Commission must take action.

A. Anonymous Bidding Will Prevent Incumbents From Targeting Rivals.

The Commission has indicated it will not make a final decision on anonymous bidding until it releases the *Public Notice* on specific auction rules subsequent to its resolution of this *FNPRM*.[49] The *FNPRM* nevertheless solicits comment on the relative benefits of anonymous bidding versus the benefits of open bidding, and whether choice of band plan has any impact on this calculus. The *FNPRM* also solicits comment on whether use of anonymous bidding will impact the participation in the auction.

1. Analysis of the AWS auction reveals that open bidding permitted incumbents to engage in signaling and blocking behavior that discouraged new entrants and reduced potential auction revenues.

The studies previously submitted into the record of this docket (and appended to these comments) by Dr. Rose demonstrate that use of anonymous bidding is a *sine qua non* of

[49] ¶246.

achieving the Congressionally-mandated goal of a competitive auction that both maximizes the likelihood of new entrants and ensures an appropriate return to the public for the use of valuable public licenses. While other factors – such as combinatorial bidding and larger license size – work synergistically to facilitate entry by new competitors, none alone is sufficient. Only anonymous bidding can prevent incumbents from explicitly targeting new entrants, or eliminate the problem of signaling via bidding. Given the large number of objects in the auction even under the plans with the largest number of REAG licenses, it is impossible to eliminate the ability of interested parties to signal one another via bids in an open auction.

PISC adds that, in light of the reports submitted by Dr. Rose, the Commission must resolve an ambiguity in the existing anti-collusion rules. To the extent PISC can determine, it remains ambiguous whether an agreement by bidders to actively block specific bidders or whether communications limited to blocking bidders violate the anti-collusion rules. The Commission would do well to clarify this before the beginning of the 700 MHz auction.

Even absent an explicit coordinated conspiracy to block new entrants, however, the studies demonstrate the validity of previous theoretic studies that predict that incumbents will inevitably use their familiarity with the auction both to engage in retaliatory bidding (and other signaling behavior) and to block or drive up the cost of licenses to rivals. From a policy perspective, it makes no difference whether the demand reduction effects of retaliatory bidding or the exclusion of disruptive competitors occurs by accident or design. The relevant question to the Commission is whether it wishes to prevent such outcomes in the 700 MHz auction. If so, then the Commission should adopt anonymous bidding.

2. To the Extent Open Auctions Genuinely Benefit Non-Incumbent Bidders, Those Benefits Do Not Exist Here.

As the *FNPRM* observes, many of the hypothetical advantages of open bidding simply do not exist in the context of the 700 MHz auction because the need to "know your neighbor" is substantially reduced.[50] The issue of compatible technologies and potential business partners in neighboring license areas can have no impact here, where technologies have not yet developed and where companies remain coy about their future business plans.

Other supposed advantages from open bidding, such as knowledge of opposing bidders so that a party can use knowledge about that bidder to avoid conflict or retaliate by bidding on an opponent's "must have" licenses, violate the basic rationale for spectrum auctions. In theory, spectrum auctions promote efficiency because each bidder understands the value of the license to itself and bids accordingly, thus ensuring that the license will go to the licensee that most values it. To encourage bidders to bid on licenses because they are engaged purely in strategic behavior based on the identity of their opponent undermines this rationale. Worse, such "advantages" favor the larger, better informed incumbents able to exploit the weaknesses of opponents or scare off rivals with fewer resources. While permitting these options by maintaining open bidding may be advantageous to individual bidders, they do not serve the public interest and the Commission should not consider them positive aspects of open bidding.

3. The Commission Cannot "Fix" the Modified Eligibility Ration, Nor Should It.

Even if one accepted that the supposed advantages of open bidding served the public interest, the Commission should not attempt to refine the modified eligibility ratio. As members

[50] *FNPRM* ¶248.

of PISC observed in opposing adoption of the T-Mobile "compromise," the theory that a sufficiently competitive auction will avoid the problems of signaling and prevent incumbents from targeting new entrants has no basis in the theoretical literature or in empirical studies.

The ease with which parties apparently manipulated the rules in the AWS auction demonstrates that only adoption of anonymous bidding in all circumstances can protect the integrity of the auction. Because the Commission allows parties to correct imperfect applications, parties willing to front "dummy" bidders to drive up the ratio have the opportunity to game the system with precision. After the initial application round, the parties fronting dummy bidders will correct a sufficient number of applications to ensure that – as happened in the AWS auction – just enough bidders qualify to trigger the open bidding rules.

As no theoretical or empirical justification for the modified eligibility ratio exists, there is no reason for the Commission to create opportunities for rule manipulation. The Commission should simply abandon efforts to capture the "benefits" of open bidding and adopt anonymous bidding.

4. The Larger the Number of Licenses, the Greater the Need for Anonymous Bidding.

The *FNPRM* explicitly asks whether choice of band plan has an impact on the need for anonymous bidding.[51] While PISC supports anonymous bidding in all cases, the need for anonymous bidding increases with the number of licenses in the auction.

Briefly, the more objects in the auction, the greater the ability to convey information through bids (or failures to bid) on the auction. Each additional object creates a new possible signal directly, and in combination with, the existing objects.

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[51] ¶249.

Furthermore, the increased number of licenses creates additional opportunities for incumbents intent on blocking new entrants. As the number of licenses needed to establish a significant regional footprint or national footprint grows, so does the number of licenses an incumbent can hold to block also grows. While combinatorial and package bidding can help minimize this sort of block behavior, it cannot eliminate the increase in the overall ability of bidders determined to block rivals if the number of packages is small, the licenses included in the packages are clearly identified, and the identities of the bidders (and their overall spectrum requirements) are known. On the other hand, anonymous bidding combined with combinatorial bidding can facilitate the acquisition of regional or national footprints.

B. Exclusion of Incumbents/New Entrant Credits

The single most direct means to facilitate new entry is to prohibit incumbents from participation. In the past, the Commission has employed such one-time auction bans to ensure that a proper level of competition emerges, relying on no further evidence than the need to facilitate new entry. For example, when the Commission auctioned DBS channels in 1996, it adopted a one-time rule prohibiting existing DBS providers from bidding (or, alternatively, requiring them to trade their previous channels for new channels).[52] The Commission imposed the rule after its analysis of both the DBS market and the MVPD market as a whole forced it to conclude that both markets would benefit from the deliberate effort to introduce new competitors via the auction process.[53]

Even without the evidence that incumbents targeted potentially disruptive new entrants,

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[52] *Revision of Rules and Policies for the Direct Broadcasting Satellite Service*, 11 FCC Rcd 9712 (1996).
[53] *Id.* at 9726-39.

the need to ensure "fresh blood" in the wireless service and broadband markets would justify barring wireline broadband incumbents and large wireless incumbents from participation, as it did in the 1996 DBS auction. Here, however, the Commission has two additional pieces of evidence to consider. First, as discussed at length in Part I, it appears highly unlikely that incumbents will build the open third pipe that the Commission and others have insisted they wish to see emerge from this auction. Second, as indicated in the Rose Report on incumbent blocking, there is strong evidence to suggest that allowing incumbents to participate in the auction will prevent new entrants from winning significant licenses.

Alternatively, the Commission proposes a "new entrant credit" to make it possible for new entrants to compete against deep-pocketed incumbent rivals. While this approach does not have the same certainty as a ban on incumbent participation, it does have several positive aspects to recommend it. Given the history of manipulation of credits by large incumbents as set forth by Council Tree in Docket No. 05-211, the Commission must take care in establishing the rules to properly define "new entrant" and prohibit relationships with entities that have incentive to exclude genuine new competitors.

C. Band Plan Issues

The Commission should adopt band plans that facilitate creation of national providers to achieve necessary economies of scale, while still protecting the public safety issues raised by supporters of the Band Optimization Plan (BOP). Accordingly, the Commission should adopt the first additional proposal, which would maximize the number of REAG licenses in the Upper 700 MHz auction while permitting resolution of the Canadian Border Area issue. If the Commission does not adopt the proposed BOP alternative, the Commission should adopt Band

Plan 1 for the Upper 700 MHz Band.

The reasons given by SpectrumCo and others for adoption of predominantly smaller licenses have little, if any, merit. The Commission has already determined that it will offer more than 800 EA and CMA size licenses in the Lower 700 MHz Band. This combination, particularly when coupled with the open access proposals, provides more than enough spectrum for rural providers and smaller new entrants not seeking a national footprint.

Closer examination demonstrates that the real division of opinion on the band plan is not rural versus urban. Rather, the push by SpectrumCo and large wireless carriers for smaller licenses appears designed to bolster their ability to block potential competitors from developing powerful national networks that would challenge their existing broadband and wireless offerings. That incumbents, Verizon and AT&T, have sided with the DBS Wireless and the 4G coalition emphasizes this point. It appears that Verizon and AT&T hope to use these licenses for a competitive "quad play" against cable, a move which would challenge not merely SpectrumCo's current broadband and video dominance, but would also threaten the stand alone wireless providers as well. By contrast, Comcast and Time Warner – the principle cable investors in SpectrumCo – have repeatedly maintained that they have no interest in entering into head-to-head competition with the likes of T-Mobile and MetroPCS. Absent this understanding, it seems odd that SpectrumCo should express such altruistic concern for rural providers and "backyard entrepreneurs" by insisting that the Commission adopt a band plan that emphasizes smaller licenses.

D. Build-Out Requirements

PISC applauds the Commission for proposing meaningful build-out requirements and agrees with the general proposal that licensees should be subject to a "use or lose" license condition that will allow residents of unbuilt areas the use of this valuable spectrum. At the same time, however, PISC also recognizes that new entrants may face high start-up costs and the challenges of establishing a wholly new infrastructure. More stringent build-out requirements appropriate for incumbents with a history of warehousing spectrum and neglecting rural areas may therefore not be appropriate for new entrants. However, the Commission should be vigilant that all licensees build-out service in a reasonable and timely manner or adopt some other mechanism for utilizing the spectrum.

PISC proposes several ways to implement "use or lose" with rigorous build-out requirements without discouraging potential new entrants or imposing undue burdens on Commission staff. First, PISC reiterates its previous proposal that, rather than reclaim spectrum, the Commission designate unserved areas as "vacant channels," usable by unlicensed devices approved in OET Docket No. 04-186. Second, PISC recommends that the Commission consider proposals that will allow new entrants to demonstrate that failure to meet the service requirements results from genuine difficulties rather than from an intent to warehouse spectrum or leave rural areas unserved.

E. Designated Entity Credit & Two Sided Auction

PISC again urges the Commission to resolve the pending issues in Docket No. 05-211 swiftly. The Commission should grant the Council Tree/MMTC *Petition for Reconsideration* and should set rules limiting the relationships between designated entities (DEs) and large wireless incumbents as proposed in the *Further Notice* in that proceeding.

PISC supports extending the DE credit to bidders on the E Block spectrum. However, PISC strongly urges that the Commission resolve the outstanding rulemaking on the modifications of the DE credit and prohibit DEs with material relationships with large incumbent operators from receiving DE credits. Alternatively, PISC recommends that the Commission adopt new entrant credits to encourage new entrants to bid on the E Block.

PISC does not believe that the Commission's recently adopted rules preventing designated entities from wholesaling their spectrum should apply to licenses subject to open access conditions. The Commission adopted the rules to prevent larger incumbents from using "sham DEs" to win licenses at a discount, then subsequently leasing the spectrum in an exclusive leasing arrangement. These considerations do not apply where a license condition requires a licensee to lease spectrum to all on a non-discriminatory basis. Accordingly, if the Commission has not granted the *Petition for Reconsideration* filed by Council Tree and Minority Media Telecommunications Council (MMTC), the Commission should either clarify that the rule does not apply to an open access license or explicitly waive the rule for this proceeding.

Finally, despite rejecting the use of two-sided auctions in the *Order* the Commission inconsistently seeks comment in the *FNPRM* on the use of two-sided auctions to clear the Guard Band B Block licenses.[54] As PISC observed in the previous round, a two-sided auction violates the plain language of the statute, which requires the Commission to deposit all revenues from

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[54] *FNPRM* at ¶187.

spectrum auctions (less certain administrative expenses) into the U.S. Treasury.[55]

The Commission has offered no reasoned explanation for how to evade this statutory command, let alone how to reconcile use of reverse auctions with its conclusion in the *Order* that, given the availability of private secondary market transactions, reverse auctions are not necessary to realize public interest benefits from the Guard Band B licenses.

CONCLUSION

The PISC appreciates the opportunity to submit these proposals to enhance competition and promote the development of a third pipe in the upcoming 700 MHz auctions. The evidence clearly shows that existing incumbents have no interest or incentive to use the valuable 700 MHz spectrum for its highest and best use – deployment of a third pipe to American consumers. Given that the U.S. continues to fall behind our international rivals in broadband deployment and accessibility, the Commission simply cannot continue its past practices and "let the chips fall where they may." The Commission must take affirmative steps to encourage new entrants into the wireless broadband market and to make sure that the licensees of the 700 MHz band provide service in a manner that meets the needs of the public, not the needs of their shareholders. We urge the Commission to adopt each of the proposals discussed above.

[55] 47 U.S.C. §309(j)(8)(A).

Respectfully submitted,

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APPENDIX A

An Engineering Assessment of Select Technical Issues Raised in the 700 MHz Proceeding

An Engineering Assessment of Select Technical Issues Raised in the 700 MHz Proceeding

Prepared for

Free Press

Media Access Project

May 2007

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I. Introduction

This Report presents the results of an engineering evaluation of some of the issues raised by the Further Notice of Proposed Rule Making with respect to the 700 MHz auction currently under consideration before the Federal Communications Commission.

The Report was prepared in May 2007 by Columbia Telecommunications Corporation (CTC) at the request of Free Press and Media Access Project. The Report addresses some of the technical issues raised by the debate over how to allocate spectrum in the upper tier of the 700 MHz band to best serve the public interest and to make viable emergence of a "third pipe" broadband alternative to cable modem and digital subscriber line (DSL) services. Specifically, this Report:

- Describes how a broadband wireless network operates
- Describes how an "open access" broadband wireless network operates and discusses how such an open access network differs from a network limited to only one service provider
- Discusses how an open access network enables greater engineering efficiencies (and therefore, better use of scarce spectrum) than a single-provider network
- Discusses how allocation of larger blocks of 700 MHz spectrum is more likely to result in a technically competitive "third pipe" because it will enable greater speeds and lower costs per bit for both deployment and operations
- Briefly describes the flexibility of the open access architecture to allow for integration of smart radio technologies such as real-time spectrum auctions in the future as such technologies emerge

II. How a Broadband Wireless Network Operates

A broadband wireless network consists of three major parts – the radio access network (RAN), the backhaul network, and the core and interconnect network. Figure 1 provides a schematic representation of such a broadband wireless network.

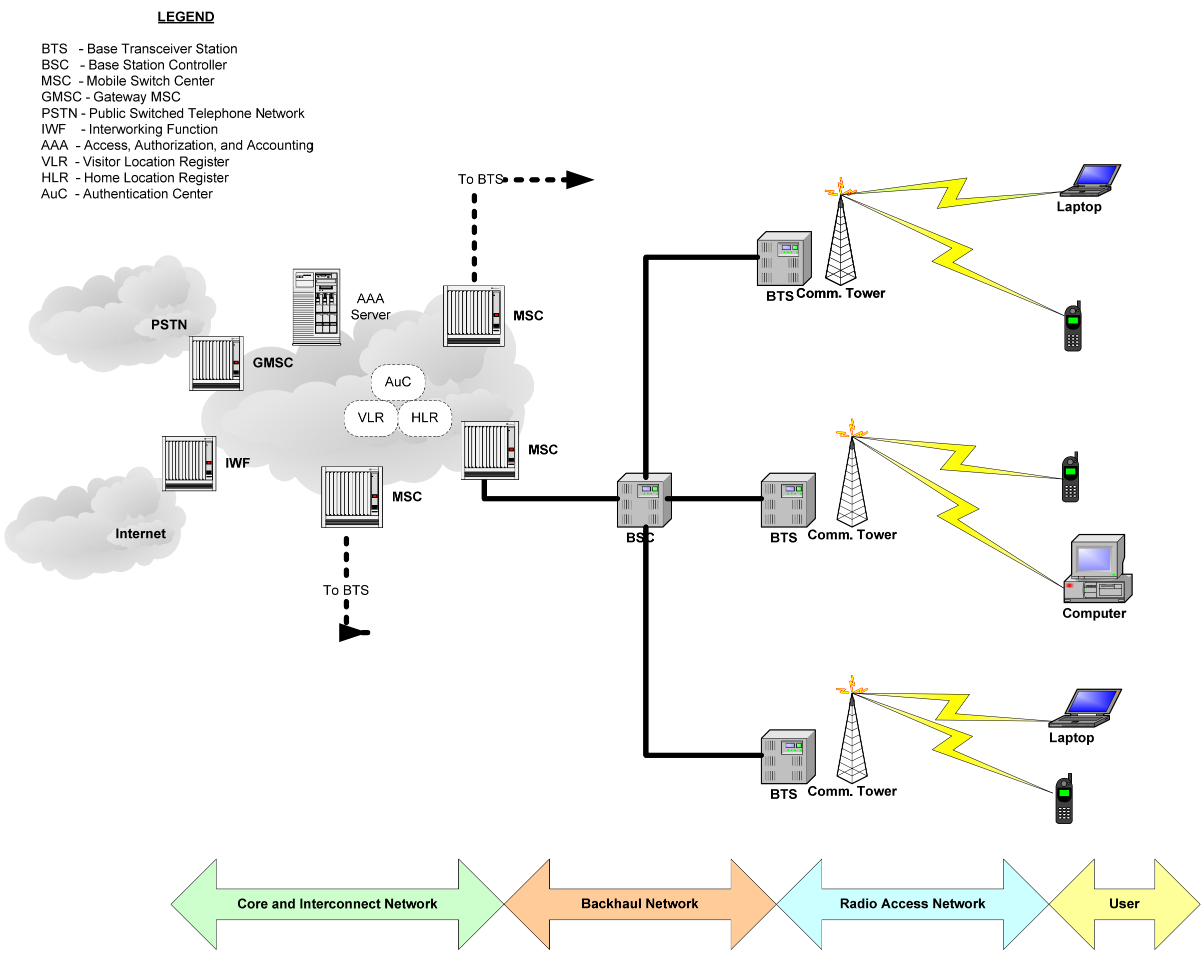

Figure 1: Key Parts of a Wireless Network

The user interacts with the network by using customer premises equipment (CPE) compatible with the network. Examples of CPE include mobile telephones, personal digital assistants (PDA), laptop computers with internal or external antennas, and fixed wireless CPEs installed at homes and businesses. Generally, the CPE is owned by the user or leased from the wireless operator. In order to connect with the network, the user must have an account or be otherwise authorized to connect. The network performs authentication of the user by matching the identity of the CPE (usually a serial number) with a particular account and that account's status.

The user's CPE makes a connection with the RAN segment through the radio interface between the CPE and network operator antenna. Antennas are located on monopoles, on rooftops, on utility poles, and in building facades. The spacing of the antennas depends on the design of the system and the capacity and RF coverage requirements of the area. More antennas are needed in busy areas, as well as in areas where there are physical obstructions, such as terrain and buildings. Typical antenna spacing on a cellular/PCS/broadband network providing broadband wireless services is 1.5 kilometers in a suburban area.

The base transceiver, located close to the network operator antenna, manages the radio communication, including power levels and available transmission speed over the link. The wireless transmissions to and from multiple base transceivers are then aggregated at a base station controller site, located regionally. The base station controllers are finally linked to a mobile switching center, where the central switching intelligence is located.

The connections between the antennas/base transceivers, the base station controller, and the mobile switching center together constitute the "backhaul" network. Generally, the backhaul requires fiber optic technology because of the high capacity needs of a broadband wireless network. Provisioning high-speed fiber optic services every mile is one of the most costly and logistically challenging aspects of building a broadband wireless network.

The service provider switching centers interconnect the wireless service provider with outside networks, including the Internet and the public switched telephone network (PSTN).

A. The radio access network

The radio access network provides wireless communications between user devices such as mobile phones, laptops and home modems on one end, and the network operator antennas on the other end.

The network provides service to fixed, nomadic, or mobile subscribers over an air interface. Multiple base transceiver stations (BTSs) are deployed over the service area. The BTS provides the radio equipment needed to establish communications over the air interface with web-enabled phones, broadband wireless-enabled laptop or desktop computers, home transceivers connected to an external antenna, and other broadband wireless devices, together known as customer premise equipment (CPE).

Some BTS can provide service using multiple spectral bands. BTS could also be multi-protocol and provide services simultaneously using multiple wireless communications standards (for example, CDMA, GSM, WiFi, and WiMax).

B. The backhaul network

The backhaul segment of the wireless network interconnects the network's wireless antennas with the network's mobile switching center.

The backhaul network consists of transmission and switching equipment that interconnects the BTS to the core of the network. The base station controller (BSC) interconnects multiple BTS and aggregates traffic. The mobile switch center (MSC) connects to the BSCs and provides the switching functionality and processing required to authenticate and set up connections to the rest of the parent network, including the public switched telephone network, the Internet, VoIP networks, and other wireless networks. Multiple-T1 and Ethernet links are typically used to interconnect MSC and BTS. As the need for backhaul capacity increases, higher capacities can be provisioned using T3, optical OC-N, and high-speed Ethernet technologies.

C. The core and interconnect network

This segment of the wireless network serves as the wireless network's backbone and also connects the network to other wired and wireless networks, including the Internet and the public switched telephone network.

The core and interconnect network consists of the interconnections between multiple MSCs, gateway MSCs, and the servers and databases such as the home location register (HLR), visitor location register (VLR), and authentication center (AuC) with Access, Authorization, and Accounting (AAA) servers that are integral to mobile network operations. The transmission links between MSCs are typically fiber optic.

III. Open Access Can Effectively Be Engineered Over a Broadband Wireless Network

The general organizational scheme described above is no different in an open access network. The only difference is that in an open access environment, multiple entities connect with this infrastructure at the switching centers, and subscribers to many service providers are able to connect through the same infrastructure.

From an engineering standpoint, wireless broadband networks are well-suited to open access arrangements. An open access infrastructure can be engineered and operated in many different ways using existing technologies and could offer such far-ranging services as voice, text and picture messaging, broadband access, and video.

Wireless open access is achieved by appropriately engineering the wireless network. As more users enter the network or as demand increases in particular geographic areas, the infrastructure service provider can increase coverage as needed so long as the infrastructure is built to be scalable. For example, the infrastructure owner can enhance the RF capacity of the existing network simply by adding or segmenting base stations, which would have the effect of enabling more potential users in a particular geographic area to connect at higher speeds to the network. If the network backhaul is built with fiber optics, upgrading network capacity to a given base station can be as simple as upgrading the network's electronics to higher-speed technologies.

Figures 2 and 3 below illustrate the similarities and differences between carrier-grade wireless networks for single providers (Figure 2) and multiple providers in an open access environment (Figure 3). Figure 2 shows the system-level configuration of a standard wireless broadband infrastructure that supports a single wireless service provider (WSP) over the proprietary network. The network infrastructure consisting of the RAN, backhaul, and core network are owned and operated by the spectrum licensee network operator. In addition, the same network operator owns and operates equipment supporting voice, data, and video services. All paying end-users of the wireless network are customers of the same spectrum licensee network operator. This general configuration is consistent with that used by wireless broadband carriers Verizon Wireless, Cingular, and Sprint/Nextel.

Figure 3 shows a system-level configuration of an open access wireless broadband infrastructure that supports multiple wireless service providers (WSPs). This configuration is described below. This configuration compares most closely to carrier broadband wireless architectures and is illustrated here to demonstrate the compatibility of carrier networks with open access. There are several other suitable architectures, including use of mesh and hotspot technologies and of WiMax.

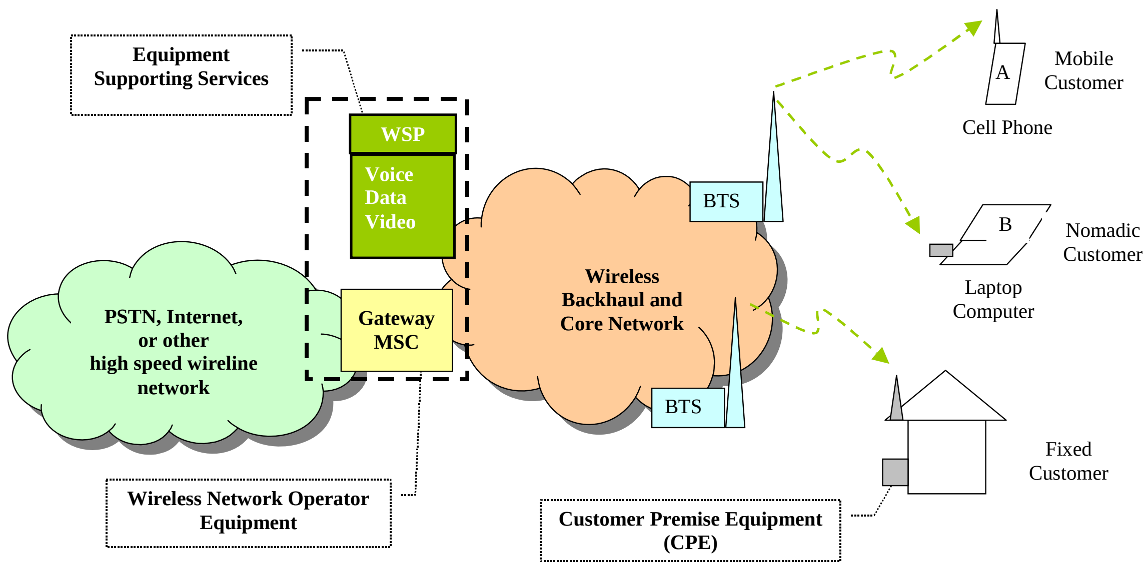

Figure 2: Generic Wireless Broadband Network, Supporting a Single Service Provider

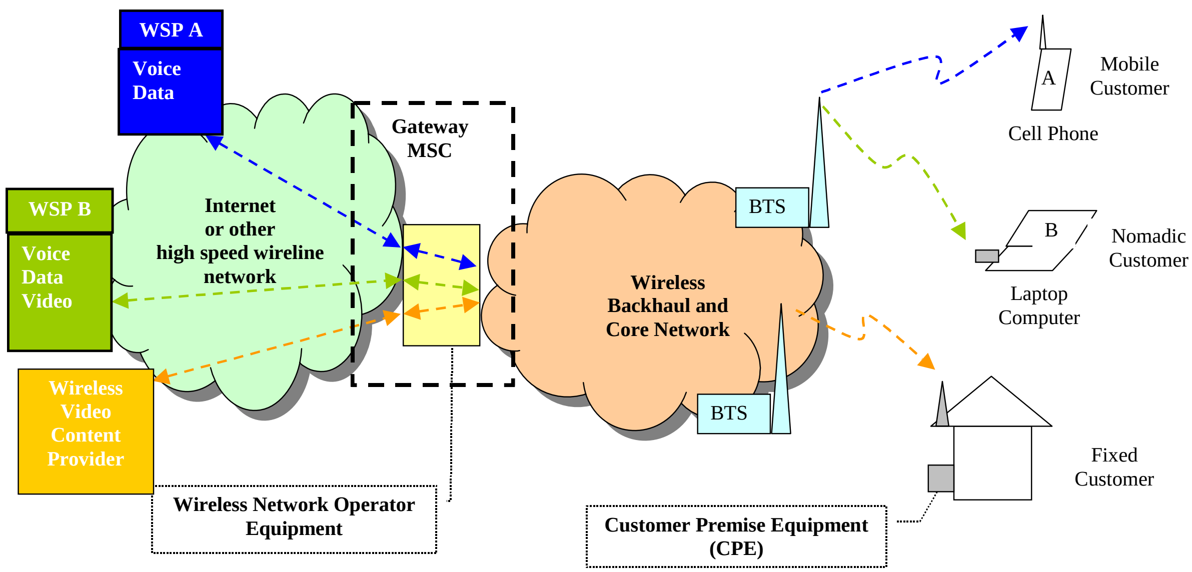

Figure 3: Generic Open Access, Supporting Multiple WSPs over a Single Network

In the example in Figure 3, each wireless end-user connects to the radio access network with one of three distinct service providers.[1] The wireless infrastructure operator owns the wireless network consisting of the spectrum license, antenna, the backhaul and core network, the BTS, BSC, MSC, GMSC, and access to the towers. The customer premise equipment (CPE) could be owned by the service provider (this equipment could include

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[1] Three providers are used for purposes of illustration. There is no theoretical technical limit to the number of service providers.

the WiMax antenna and radio) or the end-user (this equipment could include a cell phone or broadband wireless card on a laptop).

The wireless infrastructure operator provides transmission services at wholesale rates to the various service providers. Service level agreements between the network operator and the service provider would dictate service attributes such as the number of users support, maximum bandwidth supported, and quality of service. The wireless service providers could offer a bundle of services including telephony, video, and Internet access. In this example, WSP A offers a triple-play bundle of services, WSP B provides only voice and data, and the third WSP is exclusively a video content provider. Subscribers could select one service provider to get all three services, or pick services from different service providers. In this example, subscribers A and B obtain services from WSP A and WSP B, respectively. Subscriber C, however, only obtains video services from the third provider.

Open access in this model compares closely to existing, operational open access networks in wired communications, including provision of services from multiple retail service providers on cable modem, DSL, and fiber optic networks in the United States, Europe, and Asia.

IV. Open Access Enables Greater Engineering Efficiencies than Allocation of Spectrum to Individual Providers

Open access conditions can make highly effective use of the available channels, if thoughtfully and thoroughly developed, enacted, and enforced. Open access makes highly efficient use of the spectrum relative to a band plan with multiple providers on multiple channels in the following ways:

- First, efficiency arises from the sharing, by multiple providers, of a single platform with a single set of antenna structures, base stations, backhaul, management systems, and RF designers.

- Second, efficiency arises from full use of all allocated spectrum on an open access platform. In contrast, a scheme with multiple bands assigned to many individual providers will result in a greater loss of spectrum use because of the need for guard bands and mitigation of RF interference among the many individual providers/bands.

- Third, in an open access environment, each provider can offer a higher theoretical maximum speed to their customers – their speeds are determined by the bandwidth of the *large* shared spectrum block, rather than the bandwidth of the *smaller* channel. In a well-designed network, multiple users would regularly approach a peak speed more than twice as fast as the speed they would reach if the spectrum were simply split between two or more providers (Figure 4). The technical workings of this efficiency are described in greater detail in Section V below.

- Fourth, there is no technical limit to the number of retail competitors on an open access channel, while the non-open access band plan limits competition to the number of blocks provided for commercial use.

In an open access environment, there are a number of key technical arrangements to be managed in the relationship between the infrastructure provider (who manages the RF platform and backhaul network) and the retail service provider. From an engineering standpoint, none of these issues is problematic. The arrangements to be managed include:

1. Requirement for minimum level of RF coverage;
2. Demarcation and peering between infrastructure providers and retail providers at access points in multiple metropolitan areas;
3. Requirements for RF or capacity enhancement based on dropped communications or request of retail provider;
4. Ability for any standards-based hardware to have access to the platform; and
5. Ability for a customer with standards-based hardware to sign up with any available retail provider in that region.

Some of the more challenging technical matters include:

1. Developing and enforcing standards and rules for access to the network;
2. Setting enforceable performance standards for the infrastructure provider; and
3. Determining and prioritizing RF coverage areas and RF mitigation and scaling of capacity.

V. Allocation of a Large Channel is Most Likely to Result in a Technically Viable Third Pipe

From an engineering perspective, the goal of a “third pipe”—high speed performance at a competitive price—is best served by the largest channel, and the way the Upper 700 MHz Band can best deliver a third pipe is with availability of paired channels of 10 MHz or larger.

A. A large channel can better compete technically with existing wired services

In our opinion, 10 Mbps per customer is the current baseline for a viable third pipe, particularly in metropolitan areas where cable modem and DSL services are widely available.[2]

It is important to note, however, that by the time the 700 MHz networks are built and become operational over the next decade, the baseline will have risen in metropolitan areas where cable modem or fiber-to-the-premises service is available, perhaps as high as 20 or even 50 Mbps.[3]

A network built on an allocation of 5 or 5.5 MHz paired channels of spectrum will reach peak aggregate speeds[4] of ~12 Mbps, shared among users in a particular service area—speeds that are technically competitive in today's environment, but likely not that of 10 years from now.[5] Only allocations of 10 MHz or more paired channels can potentially provide peak speeds of ~24 Mbps or more shared capacity among users in a particular service area– speeds that will be able to compete with DSL and cable modem service in the future years when the 700 MHz service actually becomes available, assuming the spectral efficiency of existing and foreseen technologies.

With time, cable and DSL providers will continue to increase speeds by upgrading electronics and physical plant. The wireless providers will need to continue to upgrade their technologies to remain a competitive third pipe.

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[2] Cable companies can provide more than 10 Mbps per customer using existing DOCSIS 2.0 technology and phone companies can offer speeds comparable to the current generation of cable modem through advanced DSL services (where they are available). Though this may be the baseline for technical competition in metropolitan and densely-populated areas, these networks and speeds are not available in many parts of the country, particularly rural and low-density areas.

[3] Cable modem service speed is expected to reach high as 100 Mbps with adoption of new technologies such as DOCSIS 3. Emerging fiber-to-the-premises networks are capable one Gbps, and even the long-awaited fiber-to-the-node networks (such as AT&T's U-Verse) may offer 10 Mbps or more if they are successfully built.

[4] "Peak speed" represents the maximum theoretical speed possible over a data network. Peak speed is a calculation equal to the spectrum bandwidth multiplied by the maximum spectral efficiency of the system. The peak speed, minus losses due to overhead, will be divided among the simultaneous users of the spectrum.

[5] This analysis assumes the use of existing CDMA broadband wireless technology, with placement of base stations at reasonable intervals analogous to network segmentation for PCS/cellular technologies.

Table 1: Peak Speeds Possible under Different Channel Allocations and With Other Technologies

	5.5 MHz Wireless Allocation	11 MHz Wireless Allocation	Cable Modems		ADSL
			DOCSIS 2.0	DOCSIS 3.0	
Upstream RF Bandwidth Available	5.5 MHz	11 MHz	Up to 6.0 MHz	3.2 MHz to 24 MHz or greater	200 KHz
Downstream RF Bandwidth Available	5.5 MHz	11 MHz	6.0 MHz	6 to 24 MHz or greater	2 MHz
Spectral Efficiency (Peak Speed / Spectrum Bandwidth)	2.4	2.4	4 to 7	4 to 7	6 to 12
Maximum Theoretical ("Peak") Downstream Speed	12 Mbps	24 Mbps	43 Mbps	160+ Mbps	24+ Mbps

B. A large channel will offer proportionally higher speeds than smaller channels because the theoretical maximum speed scales with the size of the channel

As a matter of engineering and physics, allocation of larger channels will enable proportionally higher peak speeds compared to smaller channels.

Peak speed is a critical parameter in evaluating the performance of any data network. It is an important number because it can be quantified (and compared to other network peak speeds) more easily than average speeds, which will vary dramatically depending on location, time, usage pattern, application, and many other factors. Peak speed is a useful way to gauge the maximum capabilities of a network and therefore is one way to evaluate how best to allocate scarce spectrum. Absent authoritative figures on average speed, peak speed is one way to determine which channel allocation is most likely to produce a viable third-pipe -- one that may compete technically with DSL and cable modem service. Where we discuss peak speed here, we are not suggesting that these speeds will be available to all users at any or all times; rather, we are recommending that potential network performance can be gauged be comparing peak speeds because this speed will be available in the aggregate to all users.

From an engineering standpoint, the only way to increase peak speed available to any individual user is either to allocate more spectrum or to improve spectral efficiency. "Spectral efficiency" refers to the network's ability to use the available bandwidth to obtain the highest speed.[6]

A shared data network connection, as long as it is not saturated, provides an actual transmission rate greater than the total capacity divided by the number of users (mean speed) even if not quite at peak speed.[7] This is true because of the bursty[8] nature of data and Internet traffic. As a result, a 5 MHz channel block cannot achieve comparable speeds to a 10 MHz channel block. Hypothetically if a 5 MHz can provide its users with speeds of 7 or 8 Mbps, a 10 MHz provider can potentially provide speed of 14 to 16 Mbps in the same environment and same conditions, using the same technology.

Figure 4 illustrates how speeds scale up in proportion to increases in channel size, and scale down in proportion to decreases in channel size. Each illustration in the Figure shows a total allocation of 11 MHz—allocated in its entirety to one operator in the first illustration; and divided between two operators (5.5 MHz each) in the second.

[6] Spectral efficiency is the speed the system can offer using a certain amount of bandwidth; in other words, the data rate/speed in Mbps using a particular spectral bandwidth in MHz.

[7] This is true whether over wireless or cable modem, both shared media.

[8] "Bursty" is defined as the constantly changing bandwidth or bandwidth requirements that are typical of certain Internet applications and traffic. Bursty traffic is not constant in nature, but has a wide, dynamic range from very low to very high bandwidth utilization. For example, browsing a web site rich in multimedia content will require constantly changing bandwidth, varying in bandwidth need from 0 kbps while the user reads the page, to 30 kbps when the user downloads a new text page, to 5 Mbps or higher for a short time while downloading a large image or audio file. In contrast, streaming media (audio/video) typically does not require bursty bandwidth – it has very constant requirements (a 768 kbps videoconference, for example). Although streaming and multimedia applications are becoming common, the majority of Internet traffic remains bursty and variable in its capacity demand.

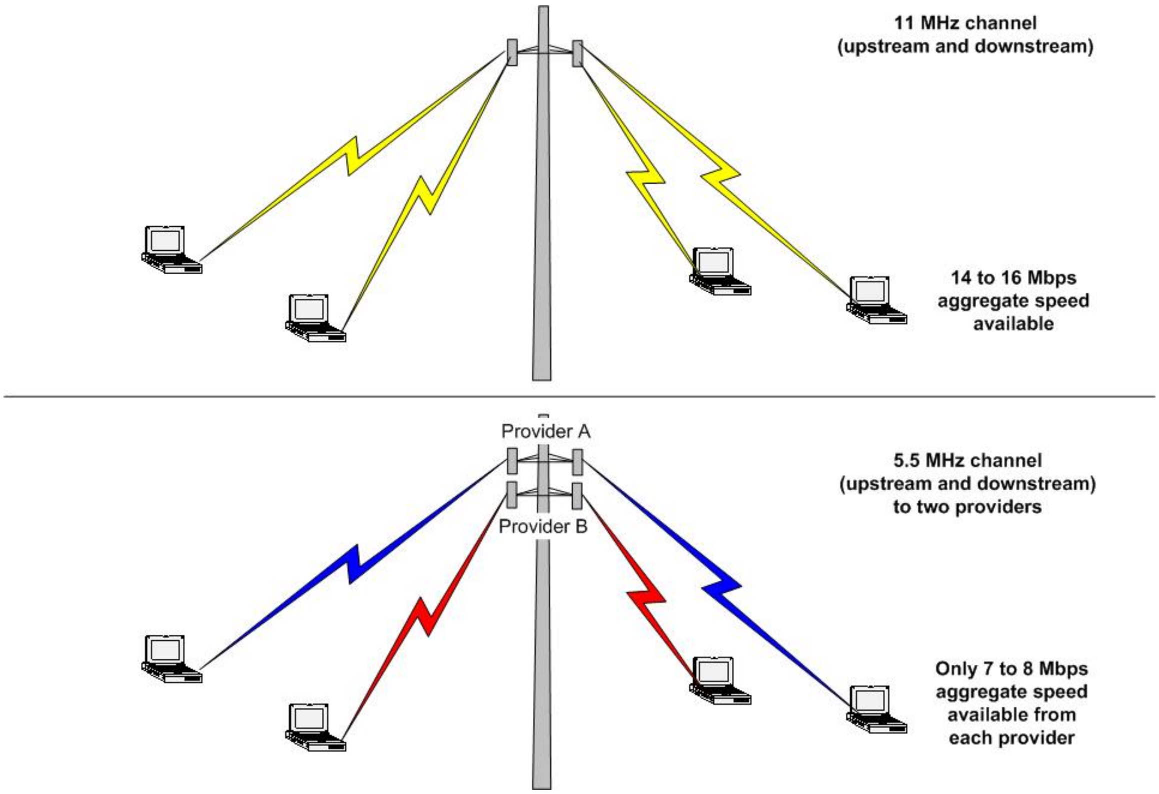

Figure 4: Transmission Speed Scales in Proportion to Increases (or Decreases) in Channel Size

Spectral efficiency will continue to improve over time as wireless technology develops and improves, but improvements in actual user speeds will be limited by the many factors that reduce wireless performance, such as interference, terrain, building obstructions, and protocol overhead.

Providers will be able to serve maximum speeds to more customers over time by using advanced antenna technology and reusing spectrum by segmenting their systems, *but this will not increase the maximum theoretical speed available to any individual user—only more bandwidth and greater spectral efficiency can do that.*

C. A large channel enables engineering and network efficiencies, bringing down the cost per bit

A band plan with a large channel will minimize the capital cost per Hz allocated (and therefore the cost per bit) because a single infrastructure (with a single set of antennas, base stations, backhaul, management systems) can be used to deliver many bits per second to many end-users. This band plan will enable construction and deployment of just one network, engineered to allow many providers to use it, rather than many redundant networks, each engineered for just one provider. The efficiencies of the former are obvious, and make the capital and operations cost *per bit transmitted* significantly lower than the latter.

A technically-competitive third pipe will require construction of a network with high density of antennas and the capability for intensive spectral reuse, no matter what channel bandwidth is adopted. Construction of a network will therefore require considerable capital expenditure and effort.

To the extent that open access facilitates service provider competition without requiring each service provider to construct a separate network, it is providing the benefit of price and performance competition without imposing these monumental capital expenditures on each service provider who wishes to access the capacity.

If a service provider must build a new network to activate a separate channel band, the cost of the activation may be millions or tens of millions of dollars in a single metropolitan area. As discussed above, carrier broadband wireless architectures may require base stations every 1.5 kilometers. Individual base station costs vary widely depending on environment and the needs of a particular area, but are on the order of magnitude of $100,000, plus ongoing lease fees, and several months required to plan and obtain permitting. Backhaul costs are significant, with $50,000 to $150,000 required to build a mile of fiber optic cable, or thousands or tens of thousands of dollars per month required to lease comparable capacity from a service provider. Hotspot and mesh technologies may be less expensive on a per-base station basis, but would require many more antennas to operate.

D. A large channel can be more easily and efficiently engineered than can combining multiple smaller channels to achieve comparable functionality

As discussed above, the spectrum needed for communications speeds required for a technically competitive third pipe exceeds all but the largest channel blocks under consideration. Therefore an alternative may be for the service provider to provide service to users simultaneously over multiple smaller channels. The network would then allow an individual user to achieve a peak speed comparable to the speed achievable over a single large channel. For example, a service provider could potentially combine its spectrum in the 700 MHz, PCS, and AWS bands and use unlicensed spectrum.

However, there are technical complexities in a single customer simultaneously connecting over multiple bands widely separated over the spectrum, and this is not typically done by commercial broadband wireless providers. It is not realistic at the moment for a single user to simultaneously upload or download over multiple spectral bands using current technologies.

Some service providers currently use multiple bands to provide cellular and PCS services to users, and CPE equipment is capable of connecting over multiple bands. At any given moment, the individual user is only using capacity in one band for broadband data connectivity. Existing software and hardware would need to be enhanced to enable a user to simultaneously upload and download over two or more bands.

It is therefore difficult and costly to seamlessly create the same capability over multiple small channels as with the larger channel. Combining spectrum in this manner is possible if the same entity has licensed multiple smaller channels in the same geographic area or if two or more licensees arrange from a technical and legal perspective to enable users to simultaneously connect to the two entities.

Technically, combining communications over multiple bands requires that the network and end-user CPE be designed to enable a single user to *simultaneously* use two or more systems at once, which requires synchronization between 1) the end-user CPE, 2) multiple sets of base station equipment and 3) the service provider's (or multiple service providers') switching equipment.

The user CPE and all other CPE served by a particular base station would need to establish separate connections to base station equipment for each channel band in use. Base station components are optimized for the bandwidth and spectrum of the channel band in use, so separate transceivers are required for the separate bands.

Base station equipment as currently deployed does not interact with the data stream at the level of data packets and users—that is the role of the service provider's switching equipment, which, as shown in Figure 1, is located regionally. The role of the base station equipment is to forward the data stream from the "air" to the service provider network, and vice versa, not to interact with the data or perform a combining or splitting role.

Alternatives include: 1) designing the network with a single user's multiple data streams traveling separately between the CPE and the regional switching equipment and 2) designing the base station equipment to become significantly more complex in order to read, combine, and separate information in a particular data stream between two or more channel bands.

In the first alternative, the data must arrive at the regional switching equipment close enough in time for them to be combined at the switching equipment. The requirement is particularly stringent if the communication is time sensitive (voice traffic, for example). The switching equipment must be able to recognize that both streams belong together and seamlessly combine them. As data is sent from the network to the user CPE, the network must do the opposite—it must effectively split the data at the switching equipment for apportionment between the multiple channels, forward them separately to the base station or base stations to the user CPE, and the user CPE must be able to synchronize and combine the two streams.

While Internet Protocol and other networking technologies are designed to enable communications streams to travel simultaneously over multiple paths, the problem is made more challenging with broadband wireless communications, because a user may be moving across base station service areas, the communications link quality may be variable or poor, and the communication may be time-sensitive (voice).

The complexity may be greater if the multiple channel bands are operated by separate service providers, requiring commercial arrangements as well as technical arrangements.

If the separate channel bands use separate technologies, for example, 700 MHz and satellite, the complexity is compounded. Satellite transmission latency imposes additional limitations on combining communications. The service provider would need to design its network to compensate for latency, otherwise it would be unable to effectively provide time sensitive communications as an effective third pipe. For example, the satellite link may be used for transmission in one direction and the terrestrial link for transmission in the other direction. Another alternative would be for the service provider to optimize the CPE and network software at the application level—long, continuous uploads or viewing of continuous multimedia streams may travel over the satellite link, while VoIP, short messages and browsing communications travel over the terrestrial link.

As propagation in the higher-frequency bands used for PCS, AWS, and unlicensed wireless (1.9 to 2.5 GHz) will not be as favorable as in the 700 MHz band, building penetration and terrain will affect separate bands differently. As a result, providers must ensure they have constructed base stations for high-frequency at higher density, including technologies such as indoor microcells, or the higher frequency bands may become unavailable in certain environments. As a result, the user may lose the use of one or more of the channel bands, resulting in degraded or dropped service.

E. Proposals 1 and 3 are most likely to result in a viable third pipe because they allocate the largest channels

Given the driving factor of channel size, a viable third pipe is most likely to be achieved under Proposals 1 and 3, which make available a C Band with 11 MHz in both the upstream and downstream directions.

To achieve efficient spectrum use and maximize capacity, the next best proposal is Proposal 2, which allocates a 6 MHz channel pair. Proposals 4 and 5 are least likely to serve the goal of a meaningful third pipe because 5.5 MHz channels are the largest available under those proposals.

VI. The Open Access Design Allows for Innovations Such as Real-Time Auctions as Those Technologies Emerge

One advantage of this open access architecture is its flexibility to incorporate new technologies as they emerge. The architecture does not preclude integration of innovative ideas, such as real-time auctions of bandwidth and other "smart" radio technologies, as these technologies develop and mature to carrier-grade levels.

Within the open access model, real-time auctions can be integrated in the future at two separate levels of the network: first, among retail service providers within an open access spectrum allotment, within the framework introduced in Section III; and second, between the service providers in the open access band and those in other spectral bands.

Given the policy goal of emergence of a third pipe broadband alternative, we would recommend that these emerging technologies be integrated in future iterations of the network. The open access architecture proposed above is based on currently existing technologies, deliberately selected so as not to slow the potential roll-out of technically competitive services as soon as is feasible.

Appendix A. About CTC

Columbia Telecommunications Corporation is a public interest communications consulting firm, specializing in business, policy, and engineering consulting services for public sector and non-profit clients. Since 1983, CTC has worked with the full range of existing and emerging communications technologies to provide services in strategic technology planning and deployment; communications network assessment and implementation; and project management.

During that time, CTC has provided communications engineering and other consulting services to such jurisdictions as San Francisco, Los Angeles, New York, Washington, DC, Seattle, Milwaukee, Cincinnati, Pittsburgh, Philadelphia, and San Jose—as well as numerous other communities. We have assisted many of these jurisdictions to plan, negotiate, and deploy state-of-the-art broadband networks – and to maximize public and community benefit from communications projects. As the technology and business models have evolved, our work has evolved to include numerous community broadband networks—both wired and wireless—throughout the country.

As a matter of policy and in order to provide clients with independent and unbiased advice, CTC declines any financial relationship with telecommunications and cable carriers.

APPENDIX B

TACIT COLLUSION IN THE AWS-1 AUCTION: THE SIGNALING PROBLEM

TACIT COLLUSION IN THE AWS-1 AUCTION: THE SIGNALING PROBLEM[1]

Gregory Rose

April 20, 2007

[1] The author is particularly grateful to Dr. Jesses A. Schwartz who graciously shared algorithms developed for his analysis of the PCS D, E, and F auctions.

ABSTRACT

This study utilizes the methodology developed by Peter Cramton and Jesse A. Schwartz in their 2002 paper on tacit collusion in the PCS D, E, and Block auction to identify signaling behaviors by bidders in the AWS-1 auction and measure their effects. The principal signaling behavior identified was retaliatory bidding, which occurred in the AWS-1 auction at a slightly higher level than in the PCS D, E, and F auction. Significant indirect demand reduction effects were observed in the AWS-1 auction which call into question whether the auction was revenue maximizing. The study concludes that signaling remains a serious problem for FCC spectrum auctions and recommends that anonymous bidding rules be adopted for the 700 MHz and all future FCC spectrum auctions.

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Prolegoumenon: A Tale of Anonymous Bidding.

Economic theories about competition and efficiency, and a conviction that auctioning spectrum would maximize revenue, were the basis on which Congress and the FCC authorized spectrum auctions With the accumulation of empirical evidence from actual spectrum auctions, the distance between theory and practice became increasingly apparent: bidders ued the auction rules to engage in behaviors which hampered competition and reduced the efficiency of the resulting allocations, and which threatened the expect revenue maximization which auction theorists had promised. As early as 1999 Peter Cramton and Jesse Schwartz circulated a paper which identified tacitly collusive, anti-competitive behaviors on the part of bidders – code bidding and retaliatory bidding – in the PCS D, E, and F Block auction of 1996-97.[2] These signaling behaviors were used by bidders to gain a reputation for imposing costs on those who dared to bid against them and were used to limit the ability of new entrants, fearful of retaliation, to effectively compete against some established incumbents. Most importantly, such signaling behaviors led to significant demand reduction and concomitant loss of revenue. Such signaling behaviors were possible only under conditions of open bidding.[3]

On another front, the "Linkage Principle,"[4] as it has been termed by Paul Milgrom, came under increasing attack from 1999 to 2004. The "Linkage Principle"

[2] Peter Cramton and Jesse A. Schwartz, "Collusive Bidding in FCC Spectrum Auctions," working paper, University of Maryland, 1999; the paper was later published as "Collusive Bidding in FCC Spectrum Auctions," *Contributions to Economic Policy & Analysis*, I:1 (2002), article 11.

[3] A 1999 German spectrum auction provided further evidence of collusive allocations in open-bid, ascending auctions: Mannesmann and T-Mobil essentially negotiated a division of the blocks. *Viz.*, P. Jehiel and B. Moldovanu, "A Critique of the Planned Rules for the German UMTS/IMT-2000 License Auction," working paper, University College London and University of Mannheim, 2000, and V. Grimm, F. Riedel, and E. Wolfstetter, "The Third Generation (UMTS) Spectrum Auction in Germany." *ifo Studien*, 48 (2002), 123–143.

[4] Paul Milgrom and Robert Weber, "The Theory of Auctions and Competitive Bidding", *Econometrica*, 50 (1982).

holds that auction structures which disclose more information to bidders increase auction revenue. This "principle" has been shown to be false for auctions in which multiple objects and multidimemnsional bidder types are present.[5] This was particularly important because the "Linkage Principle" is the principal theoretical rationale for open bidding. Both empirical and theoretical evidence emerged that open auctions – auctions in which the identities and bids of all bidders were disclosed to the rest of the bidders – could produce anti-competitive, inefficient, and revenue non-maximizing outcomes.

Leslie Marx, the FCC's Chief Economist, resolved to do something in response to the growing mass of evidence that open auctions were problematic, and in connection with the upcoming AWS-1 auction proposed rules for anonymous bidding. The FCC's anonymous bidding proposal was enthusiastically supported by the U.S. Department of Justice, the Federal Trade Commission, and numerous consumers organizations and public interest groups. The incumbents who were planning to bid in the AWS-1 auction launched a firestorm of criticism and an intense political campaign to prevent the adoption of anonymous bidding, including a letter to Chairman Martin threatening not to participate in the auction.[6] As one lobbyist for the incumbents told *Communications Daily*, "You can't go to the FCC and argue with an economist. This is a political play. These are businesses and this is of critical importance to these businesses. Economic

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[5] Motty Perry and Philip J. Reny, "On the Failure of the Linkage Principle in Multi-Unit Auctions," *Econometrica*, 67 (1999). More recent scholarship has extended finding of failure of the "Linkage Principle" to a wider range of auction structures: Vijay Krishna, *Auction Theory* (San Diego, CA, 2002); Thierry Foucault and Stefano Lovo, "Linkage principle, Multi-dimensional Signals and Blind Auctions." working paper, HEC School of Management, 2003; S. Board, "Revealing Information in Auctions: The Efficiency Effect," working paper, University of Toronto, 2004.

[6] Interestingly, Verizon did not oppose anonymous bidding.

theories be damned ... We'll be suited up and at the FCC."[7] Seldom have the incumbents been so frank.

The principal arguments assembled by the incumbents were that there was no need for the rules change and that anonymous bidding would prevent bidders from assessing appropriate complementarities as they bid to aggregate packages of spectrum in accordance with their business plans. Some smaller bidders weighed in with the argument that anonymous bidding prevented them from avoiding head-to-head bidding wars with the major incumbents. Consumers organizations and public interest groups argued that the problems of signaling and other anti-competitive behaviors were real and only anonymous bidding could resolve them-- especially the problem that the incumbents used open bidding to identify new entrants for exclusion from acquiring spectrum, that bidders who hadn't decided before the bidding began on complementarities among the licenses which they were seeking were admitting to having no bidding strategy, and that smaller bidders like rural telephone companies were seldom challenged by major incumbents for the spectrum on which they routinely bid. In the end, resolution of the matter of anonymous bidding was not a question of arguments, but of political muscle.

T-Mobile proposed a compromise: anonymous bidding would not be used in the AWS-1 auction unless the modified eligibility ratio fell below three, i.e., unless the eligibility of qualified bidders produced a mean of less than three bidders per license. The FCC adopted the compromise.

It is interesting that the AWS-1 auction had among its qualified bidders four which never placed a bid, and seven which bid only once. Given how narrowly the

[7] *Communications Daily*, March 28, 2006.

modified eligibility ratio reached 3.05, if these marginal bidders had not been present, the auction would have been anonymous. There was certainly the impression left that the auction rules were gamed by the introduction of "qualified" bidders whose presence was solely to ensure that a modified eligibility ratio of three was achieved so that the AWS-1 auction would not be anonymous. The vigor with which several incumbents opposed anonymous bidding raises the question of whether they had any hand in arranging the participation of these "ratio pumping" bidders in the auction. At the least, the AWS-1 auction experience suggested that "compromises" which introduce artificial conditions for implementation of anonymous bidding were an invitation for the rules to be gamed.

Anonymous bidding did not occur in the AWS-1 auction, and thus it provided a test of whose claims were the true: the incumbents or their opponents.

I. Signaling Behaviors Are a Threat to Revenue Maximization in FCC Auctions

A. Theoretical Evidence.

Signaling represents a direct threat to revenue maximization in FCC spectrum auctions. A considerable theoretical literature exists which points to the demand reduction effects of signaling and similar tacitly collusive strategies in simultaneous, open, ascending multi-object auctions.[8] The underlying intuition is that to the extent to

[8] M.S. Robinson, "Collusion and the Choice of Auction." *The RAND Journal of Economics*, 16 (1985), 141–145; George Mailath, George and Peter Zemsky, "Collusion in Second Price Auctions with Heterogeneous Bidders," *Games and Economic Behavior*, 3 (1991); F. Menezes, "Multiple-unit English Auctions," *European Journal of Political Economy*, 12 (1996), 671–684; R.J. Weber, "Making More from Less: Strategic Demand Reduction in the FCC Spectrum Auctions," *Journal of Economics and Management Strategy*, 6 (1997), 529–548; Richard Engelbrecht-Wiggans and Charles M. Kahn, "Low Revenue Equilibria in Simultaneous Auctions," working paper, University of Illinois, 1999; L. M. Ausubel and Peter Cramton, "Demand Reduction and Inefficiency in Multi-Unit Auctions," working paper, University of Maryland, 1999; Peter Cramton and Jesse Schwartz, "Collusive Bidding: Lessons from the FCC Spectrum Auctions," *Journal of Regulatory Economics*, 17 (2000); Robert C. Marshall and Michael J. Meurer, "The Economics of Bidder Collusion," in K. Chatterjee and W.F. Samuelson, eds., *Game Theory and Business Applications* (Norwell, MA., 2001); Sandro Brusco and Giuseppe Lopomo, Giuseppe, 2002. "Collusion via Signalling in Simultaneous Ascending Bid Auctions with Heterogeneous Objects, with and without Complementarities," *Review of Economic Studies*, 69:2 (2002).

which retaliation forces competitors out of bidding for a license the retaliating bidder obtains the license at a lower price than would otherwise obtain, reducing revenue from the auction by reducing demand from bidders threatened by retaliation. As Brusco and Lopomo note,

> The presence of multiple objects facilitates collusion by allowing the bidders to signal their willingness to abstain from competing over certain objects, provided they are not challenged on others. In this way, the bidders can allocate the objects among themselves without paying much.[9]

As noted above the problem of signaling is one more example of how the "Linkage Principle" is falsified.

B. The Cramton-Schwartz Empirical Studies of the PCS D, E, and F Block Auction.

In 1999 Peter Cramton and Jesse A. Schwartz circulated the results of an extensive study of code bidding and retaliatory bidding, two primary methods of signaling, in the Personal Communications Services (PCS) auction for broadband frequency blocks D, E, and F (auction 11), held from August 1996 to January 1997.[10] While Cramton and Schwartz found relatively small direct demand reduction effects in this auction -- $29.8 million to $38.1 million, depending on the estimation method – they found that signaling bidders paid 36 percent less than non-signaling bidders for the D and E blocks and 18 percent less for the F block. As they concluded, "[g]iven that signaling bidders won about 40% of the available licenses, this indicates that the indirect losses associated with signaling may be quite large."[11]

In 2000 Cramton and Schwartz published more evidence of collusion arising from

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[9] *Op. cit.*, 1.

[10] Peter Cramton and Jesse A. Schwartz, "Collusive Bidding in FCC Spectrum Auctions," working paper, University of Maryland, 1999; the paper was later published as "Collusive Bidding in FCC Spectrum Auctions," *Contributions to Economic Policy & Analysis*, I:1 (2004), article 11.

[11] *Ibid.,* 28.

signaling in the PCS D, E, and F Block auction.[12] They found a pattern which confirmed the demand reduction effects of retaliatory bidding. AT&T was both the most successful bidder and a retaliatory bidder:

> One reason for avoiding a bidder is because the bidder has a reputation for blanket retaliation or other types of aggressive bidding. Another reason to avoid a bidder is that if the bidder has deep financial resources, then there is little reason to believe that a license can be won if that bidder is interested in it. Note that these reasons are not mutually exclusive. If a bidder thinks that the other bidder has a large enough budget to win any license it wants, and there is some probability that the bidder protects the licenses it wants with retaliation, then to bid against this bidder risks a substantial cost—namely, raising the prices on the other licenses the bidder wants. Suppose there is one large bidder that wants many licenses in the auction. If it is possible to keep the prices low on the licenses this bidder will win, then this bidder may be willing to demand reduce. It sacrifices some licenses it values in order to keep its overall prices low. Thus, bidders have the incentive to avoid the large bidder, letting the large bidder win the licenses it wants at low prices.
>
> Though our reasons why bidders avoid certain others are speculative, that this is a real phenomenon is not. In the DEF auction, AT&T won 223 licenses—more licenses than anyone else. These licenses covered 140 million people, over 50% more than any other bidder. To explore whether bidders avoided AT&T, we looked at all of the bids that occurred after round 10 on the D and E blocks in markets on which AT&T was the high bidder. We ask the question: Did bidders bump AT&T when AT&T was the high bidder on the less expensive of the two blocks? If bidders did not care about the identity of the high bidder, they would arbitrage the prices of the D and E blocks, and bid against AT&T if the other block was more expensive. This did not happen. When the other block was 15% more expensive (the bidding increments were 5% or 10% of the standing high bid in the DEF auction), bidders still bid on the other block 32% of the time rather than bid against AT&T on the less costly block. When the other block was 25% more expensive, bidders still avoided AT&T 31% of the time. Even when the price of the other block was 50% higher, bidders bid on the higher priced block 27% of the time.
>
> As a comparison, we performed this same exercise to see if bidders systematically avoided smaller bidders in the same way. We chose five bidders who won between 9 and 14 licenses—ACCPCS, Comcast, Rivgam, PAccess, and Touch. We counted all of the bids made by other bidders when one of these five bidders was the standing high bidder on the D or the E block. When the other blocks were 15%, 25%, and 50% more expensive, bidders avoided these five bidders 20%, 18%, and 15% of the time, respectively.[13]

Thus, AT&T was able to deter other bidders from challenging it at a statistically significant rate far greater than a representative sample of smaller bidders. The tacitly collusive allocation of licenses which resulted exhibited demand reduction.

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[12] Peter Cramton and Jesse A. Schwartz, "Collusive Bidding: Lessons from the FCC Spectrum Auctions," *Journal of Regulatory Economics*, 17 (2000), 229-252.

[13] *Op. cit.,* 245-46. Cramton and Schwartz also make the point that both retaliatory bidding and sheer size had the deterrent effective, a point worth remembering when considering the asymmetrical capitalization of incumbents in most auctions.

II. Methodology

This study is in large part a replication of the Cramton and Schwartz 1999 empirical study of the PCS auction, applying the methodology which they developed to the AWS-1 auction (auction 66), held from August to September 2006. Cramton and Schwartz describe their methodology:

> To find the retaliating bids and code bids in the DEF auction, we needed a consistent way to comb through the 23,157 bids, looking for those bids resembling those examples in Section 3. Our strategy was to loop through each bid, to tentatively assume the bid was a retaliating bid, and then to check whether the bid met criteria characteristic of retaliating bids. For each bid, we used the reported information to determine which bidder made the bid, which bidder it bumped when it placed the bid (i.e., the standing high bidder as of the prior round), the market and block, and the round the bid was placed. For a bid to be a retaliating bid, it must be clear to the bidder being bumped that the bid was not meant to win the license, but was only meant to punish. Therefore, we first eliminated all bids made by a bidder that had shown interest by bidding on any block of the same market in the prior 10 rounds. Of course, if a retaliating bid was made in the previous 10 rounds, and then a follow-up retaliating bid was made, our algorithm did not catch the second retaliating bid—the program was designed to catch only the first retaliating bid.
>
> To be a retaliating bid, we required a clear motive: the bumped bidder must have recently been bidding for a market the retaliating bidder wanted. To ensure this, we required that the bumped bidder bumped the retaliating bidder from some license in the prior two rounds. We also required that within two rounds of placing the retaliating bid, the retaliating bidder had bid on the contested market; otherwise, it is unclear what the retaliating bid was meant to accomplish.
>
> If a bid met the above criteria, then it certainly met many characteristics of a retaliating bid. Our next step was to examine all of the bids returned from the above algorithm to further check that they resemble code bidding or retaliating bidding. Sometimes by looking at the retaliating bid we learned that the bid was not intended as retaliation. For example, if the bidder had bid on this market intermittently throughout the auction, then the bid was probably not meant to punish. Looking at the bids manually, we then eliminated any results returned by our algorithm included if:
>
> > 1. The bidder did not consistently adhere to a punishment strategy. If it punished once and it was not successful in deterring its rival, and then no follow-up retaliating bids were placed, then we did not view this as a retaliating bid.
> >
> > 2. The retaliating bid worked too quickly. If only one retaliating bid was placed and on a market the retaliating bidder had shown interest on earlier in the auction, if the retaliating bid did not contain a relevant market number, and if the competitor conceded, then we view this as coincidental, and not strong enough evidence to conclude that this was a retaliating bid.
> >
> > 3. The intentions of the bidder were unclear. If the bidder and the punished bidder were competing contemporaneously on several markets, and the punishing bid did not contain a market number, then we view these bids as being ambiguous in intent.

> 4. The punished bidder did not securely hold the high bid on the license being punished. If a third bidder was bidding on this market in the three rounds prior to the punishing bid, then it is not clear that the punishment had any bite.[14]

Since changes to FCC auction rules since the PCS auction have made code bidding impossible, identification of code bidding was not necessary in this study. Furthermore, while Cramton and Schwartz excluded bids before the 40th round because few licenses were obtained that early and the exclusion made their analysis more tractable, it was not possible to do so in this case, because many important licenses were obtained before the 20th round. Bids in all rounds were, therefore, subjected to scrutiny. The AWS-1 auction involved 168 qualified bidders, who placed 16,197 bids on 1,087 licenses (the FCC held an additional 35 licenses on which no bids were placed by the end of the auction). The data used was provided by the FCC.

III. Retaliatory Bidding Occurred in the AWS-1 Auction.

The algorithms described above identified 371 candidates for retaliatory bids from among 16,197 bids in the AWS-1 auction. Examination of these candidate bids for subjective factors in 1-4 in the Cramton-Schwartz methodology identified 31 of these as retaliatory bids. These bids were then designated as successful if the signaling bidder placed the winning bid on the license it sought within five rounds of placing its retaliating bid(s); unsuccess was simply the absence of success Table 1 presents this distribution:

[14] Ibid, 8-9.

Table 1.
Retaliatory Bids in the AWS-1 Auction

	BEA[15]	CMA[16]	Total
Successful	7	6	13
Unsuccessful	5	13	18
Total	12	19	31

Retaliatory bids constituted, thus, 0.19 percent of all bids placed in the AWS-1 auction. In the PCS auction Cramton and Schwartz identified 37 instances of retaliatory bidding, or 0.16 percent of all bids placed in the PCS auction. However, 23 of these bids constituted code bidding, which was not available to bidders in the AWS-1 auction, leaving 14 cases of retaliatory of the sort identified in the AWS-1 auction, or 0.06 percent of the PCS bids. It is clear that retaliatory bidding has increased in the AWS-1 auction over the rate found by Cramton and Schwartz in the PCS auction. The rate of successful retaliation has decreased slightly in the AWS-1 auction, 41.94% versus 51.35%. Retaliatory bids in the AWS-1 auction were significantly more likely to be successful for the BEA licenses than the CMA licenses; this is almost certainly an artifact of the higher rates of competition seen for the CMA licenses. No retaliatory bids on REAG licenses were observed. It should be noted that retaliatory bidding took place in an auction in which the general rate of competition – an average of three bidders per license – was regarded by the FCC as sufficiently high to eliminate it as a serious possibility.

[15] There were 176 20 MHz licenses in the Basic Economic Area B Block (BEA) and 176 10 MHz licenses in the 10 MHz Basic Economic Area (BEA) C Block.

[16] There were 734 20 MHz licenses in the Cellular Market Area A Block.

IV. Demand Reduction Effects From Retaliatory Bidding Were Observed in the AWS-1 Auction.

The indirect demand reduction effects of signaling arise from awareness on the part of bidders -- and not just the bidder retaliated against -- that others bidders are willing to engage in retaliatory bidding. This awareness creates risk aversion on the part of potentially threatened bidders who respond by avoiding challenging those bidders suspected of retaliatory bidding lest they become victims of retaliation themselves. In these circumstances it becomes irrelevant whether a retaliatory bidder's retaliations are successful a majority of the time, since there is no way to predict how effective a future retaliation will be. As a result, bidders who engage in retaliatory bidding are likely to acquire spectrum at lower prices than those who do not employ retaliatory bidding.[17] Demand reduction was indirectly measured by comparison of the mean price (measured as dollars/Mhz/population) paid for spectrum by bidders which used retaliatory bidding to that paid by bidders who did not. The mean price for spectrum paid by bidders who used retaliatory $0.092 per MHz/pop. The mean price for similar spectrum paid by bidders who did not use retaliatory bidding was $0.156 per MHz/pop. A two-tailed t-test of the difference between the means was significant at $p = 0.0125$.[18] Retaliatory bidding significantly reduced prices for licenses for those bidders who engaged in it. This confirms the Cramton-Schwartz finding that indirect demand reduction effects are present when signaling occurs.

[17] This is the reason why even relatively small rates of retaliatory bidding can have considerable demand reduction effects.

[18] A two-tailed t-test assesses whether the means of two groups are statistically different from each other. A *p* value of 0.0125 indicates that 1.25 times out of a hundred you would find a statistically significant difference between the means by random chance even if there was none, i.e., a 98.75 percent chance that the significant difference is genuine.

V. Conclusions.

Careful examination of the evidence from the AWS-1 auction leads to a number of salient conclusions:

- Signaling remains a problem in FCC spectrum auctions; while code bidding was eliminated by a rule change, no effective measure against retaliatory bidding has been adopted.
- Signaling in the form of retaliatory bidding took place in the AWS-1 auction a slightly higher rate than in the PCS D, E, and F Block auction. This was despite the claim that a modified eligibility ratio greater than three would eliminate it.
- Retaliatory bidding in the AWS-1 auction resulted in indirect demand reduction as evidenced by the significantly lower prices paid by retaliatory bidder for spectrum than by bidders who did not engage in retaliatory bidding.
- Signaling in the form of retaliatory bidding depends on the ability of retaliating bidders to identify target bidders and the licenses on which they are bidding. Anonymous bidding in the AWS-1 auction would have prevented this phenomenon entirely. As a side note, I offer that the results of the AWS-1 auction completely confirm my contentions in opposition to relaxing of the originally proposed anonymous bidding rules for the auction.[19]
- The incumbents were wrong and their opponents were right. Retaliatory bidding continued in the AWS-1 auction.

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[19] "Written Ex Parte Statement of Dr. Gregory Rose on Behalf of NHMC, *et al.* in Opposition to the Proposed 'Compromise' on Anonymous Bidding," WT Docket No. 05-211/ AU Docket No. 06-33, April 5, 2006.

VI. Recommendations.

Anonymous bidding remains the only strategy for effectively defeating retaliatory bidding and other forms of tacit collusion.[20] Peter Cramton has argued for anonymous bidding:

> Concealing bidder identities. This prevents the use of targeted punishments against rivals. Unless there are strong efficiency reasons for revealing identities, anonymous auctions may be preferable.[21]

Other economists have pointed out the anti-collusive benefits of anonymous bidding. Paul Klemperer makes some useful points in a discussion of sealed-bid auctions:

> The general conclusion is that ascending auctions are more susceptible to collusion, and this is particularly the case when, as in our example, many auctions of different car models and different consumers are taking place simultaneously. As has been observed in the US and German auctions of radio spectrum, for example, bidders may be able to tacitly coordinate on dividing up the spoils in a simultaneous ascending auction. Bidders can use the early rounds when prices are still low to signal their views about who should win which objects, and then, when consensus has been reached, tacitly agree to stop pushing prices up. The same coordination cannot readily be achieved in simultaneous sealed-bid auctions, where there is neither the opportunity to signal, nor the ability to retaliate against a bidder who fails to cooperate. The conclusion is less stark when there are many repetitions over time, but it probably remains true that coordination is easier in ascending auctions. Furthermore, as is already well understood in the industrial-organization literature, this conclusion is strengthened by the different observabilities of internet and dealer sale prices which make mutual understanding of firms' strategies, including defections from "agreements," far greater in the internet case… Furthermore, this analysis ignores the impact of auction type on new entry
> in the presence of asymmetries. Because an "ascending" auction is generally efficient, a potential competitor with even a slightly higher cost (or lower quality) than an incumbent will see no point in entering the auction. However, the same competitor might enter a sealed-bid auction which gives a weaker bidder a shot at winning. The extra competition may lower prices very substantially. Of course the entry of the weaker competitor may also slightly reduce efficiency, but if competition is desirable per se, or if competition itself improves efficiency, or if the objective is consumer welfare

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[20] High reserve prices have also been suggested as a remedy on the theory because the benefit from demand reduction decreases as reserve prices increase and high reserve prices reduce the number of rounds over which bidders can negotiate a collusive allocation at relatively low prices. The principal problem is that the FCC has historically been dreadful at setting reserve prices which match market valuations: in 36.21% of auctions licenses have failed to clear at reserve price even with FCC reductions of reserve price during bidding a commonplace (cf. Gregory F. Rose and Mark Lloyd, "The Failure of FCC Spectrum Auctions," Center for American Progress, 2006). It is difficult to see how such reserve prices can be fine-tuned to eliminate demand reduction without leaving substantial numbers of licenses uncleared at an auction's conclusion. Larger license sizes have also been recommended as conducive to retarding demand reduction on the grounds that larger licenses would attract higher prices. While larger licenses might retard demand reduction generally, it does not address the necessary condition for signaling and this solution ignores the chilling effect significant license size increases across the board would have on small bidder participation.

[21] Peter Cramton, "Spectrum Auctions," in M. Cave, S. Majumdar, and I, Vogelsang, eds., *Handbook of Telecommunications Economics* (Amsterdam, 2002), 605-639). The passage is a quotation from Cramton's and Schwartz's 2002 article.

> rather than efficiency, then the case for sealed-bid auctions is very strong…[22]

Sealed bidding in standard first-price auctions performs the same functions as anonymous bidding in ascending auctions: it limits opportunities for collusion and reduces the likelihood that the presence of large bidders will deter smaller bidders from entry.

The principal arguments for retaining open bidding are (1) transparency, (2) the "Linkage Principle," and (3) a variant of the "Linkage Principle" which suggests that higher revenues can be obtained in situations where a bidder's valuation is dependent on the identity of bidders for geographically adjacent licenses. There seems little reason to be concerned with transparency prior to and during an auction: the need for transparency to verify bids and ensure rule compliance can be met by release of bidder identities at the end of the auction. The "Linkage Principle" has been savaged in the theoretical literature and substantial empirical evidence is now available to falsify it: the demand reduction effects of signaling and other collusive behaviors make it difficult to believe that revelation of bidder identities maximizes auction revenue. Even if one concedes that slightly higher revenues may result from open bidding when where a bidder's valuation is dependent on the identity of bidders for geographically adjacent licenses, there is no resason to believe that it necessarily offsets the demand reduction effects of signaling and it certainly does not address the entry deterrence effects of retaliatory bidding or bidder size. The question is: what strong efficiency reasons exist for open bidding? The answer is: none.

Strict anonymous bidding rules should be adopted for future FCC spectrum auctions, including the 700 MHz auction.

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[22] Paul Klemperer, *Auctions: Theory and Practice* (Princeton, 2004), 86-87.

APPENDIX C

HOW INCUMBENTS BLOCKED NEW ENTRANTS IN THE AWS-1 AUCTION: LESSONS FOR THE FUTURE

HOW INCUMBENTS BLOCKED NEW ENTRANTS IN THE AWS-1 AUCTION: LESSONS FOR THE FUTURE

Gregory Rose

April 20, 2007

ABSTRACT

This study examines a concerted effort by major incumbents in the FCC's AWS-1 spectrum auction to target those new entrants whose entry harbingered significant potential competitive broadband threat if (1) they acquired national AWS footprint in the AWS-1 auction or (2) they acquired a strong regional or multi-regional base from which they could acquire national footprint in future auctions. Targeted new entrants were met with a tacitly-collusive strategy of blocking bidding, coalitions of multiple major incumbents which bid for the purpose of denying licenses to the new entrant rather than acquiring the licenses for themselves. A majority of the major incumbents ceased bidding on such licenses after the targeted new entrant ceased bidding. All but two targeted new entrants were denied any spectrum in the AWS-1 auction. There is evidence in the pattern of bids that the major incumbents' blocking bidding strategy may have been explicitly collusive and the incumbents were willing to pay a significant premium to block the targeted new entrants, indicated by the significantly higher mean price they paid for the spectrum they acquired than other bidders. The study concludes with a recommendation that effective anonymous bidding rules be adopted for the 700 MHz and other future FCC spectrum auctions, since only such rules could prevent use of this anti-competitive strategy by incumbents.

The most obvious possible distortion is that since firms' joint profits in the telecom market are generally greater the fewer competitors there are in the market, it is worth more to any group of firms to prevent entry of an additional firm than the additional firm is willing to pay to enter. So too few firms may win spectrum, and these winners may each win too much, exactly as a ''hands-off'' policy to merger control will tend to create an overly concentrated industry.

-- Paul Klemperer, *Auctions: Theory and Practice*, (Princeton, 2004), 112.

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Prolegoumenon: A Tale of Anonymous Bidding.

Congress and the FCC adopted auctions as a means of spectrum allocation largely only on the basis of arguments from economic theory about competition and efficiency. Over time, as empirical evidence from actual spectrum auctions accumulated, it became apparent that there was some disjunction between theory and practice: bidders were using the auction rules to engage in behaviors which hampered competition and reduced the efficiency of the resulting allocations. As early as 1999 Peter Cramton and Jesse Schwartz circulated a paper which identified tacitly collusive, anti-competitive behaviors on the part of bidders – code bidding and retaliatory bidding – in the PCS D, E, and F Block auction of 1996-97.[1] These signaling behaviors were used by bidders to gain a reputation for imposing costs on those who dared to bid against them and were used to limit the ability of new entrants, fearful of retaliation, to effectively compete against some established incumbents. Such signaling behaviors were possible only under conditions of open bidding. On another front, the "Linkage Principle,"[2] as it has been termed by Paul Milgrom, came under increasing attack from 1999 to 2004. The "Linkage Principle" holds that auction structures which disclose more information to bidders increase auction revenue. This "principle" has been shown to be false for auctions in which multiple objects and multidimemnsional bidder types are present.[3] This was

[1] Peter Cramton and Jesse A. Schwartz, "Collusive Bidding in FCC Spectrum Auctions," working paper, University of Maryland, 1999; the paper was later published as "Collusive Bidding in FCC Spectrum Auctions," *Contributions to Economic Policy & Analysis*, I:1 (2004), article 11.

[2] Paul Milgrom and Robert Weber, "The Theory of Auctions and Competitive Bidding", *Econometrica*, 50 (1982).

[3] Motty Perry and Philip J. Reny, "On the Failure of the Linkage Principle in Multi-Unit Auctions," *Econometrica*, 67 (1999). More recent scholarship has extended finding of failure of the "Linkage Principle" to a wider range of auction structures: Vijay Krishna, *Auction Theory* (San Diego, CA, 2002); Thierry Foucault and Stefano Lovo, "Linkage principle, Multi-dimensional Signals and Blind Auctions." working paper, HEC School of Management, 2003; S. Board, "Revealing Information in Auctions: The Efficiency Effect," working paper, University of Toronto, 2004.

particularly important because the “Linkage Principle” is the principal theoretical rationale for open bidding. In short, both empirical and theoretical evidence emerged that open auctions – auctions in which the identities and bids of all bidders were disclosed to the rest of the bidders – could produce anti-competitive, inefficient, and revenue non-maximizing outcomes.

The Office of the FCC’s Chief Economist, Leslie Marx, resolved to do something in response to the growing mass of evidence that open auctions were problematic, and in connection with the upcoming AWS-1 auction proposed rules for anonymous bidding. The FCC’s anonymous bidding proposal was enthusiastically supported by the U.S. Department of Justice, the Federal Trade Commission, and numerous consumers organizations and public interest groups. And the incumbents who were planning to bid in the AWS-1 auction launched a firestorm of criticism and an intense political campaign to prevent the adoption of anonymous bidding, including a letter to Chairman Martin threatening not to participate in the auction.[4] As one lobbyist for the incumbents told *Communications Daily*, “You can't go to the FCC and argue with an economist. This is a political play. These are businesses and this is of critical importance to these businesses. Economic theories be damned ... We'll be suited up and at the FCC.”[5] Seldom have the incumbents been so frank.

The principal arguments assembled by the incumbents were that there was no need for the rules change and that anonymous bidding would prevent bidders from assessing appropriate complementarities as they bid to aggregate packages of spectrum in

[4] Interestingly, Verizon did not oppose anonymous bidding.
[5] *Communications Daily*, March 28, 2006.

accordance with their business plans. Some smaller bidders weighed in with the argument that anonymous bidding prevented them from avoiding head-to-head bidding wars with the major incumbents. Consumers organizations and public interest groups argued that the problems of signaling and other anti-competitive behaviors were real and only anonymous bidding could resolve them-- especially the problem that the incumbents used open bidding to identify new entrants for exclusion from acquiring spectrum, that bidders who hadn't decided before the bidding began on complementarities among the licenses which they were seeking were admitting to having no bidding strategy, and that smaller bidders like rural telephone companies were seldom challenged by major incumbents for the spectrum on which they routinely bid. In the end, resolution of the matter of anonymous bidding was not a question of arguments, but of political muscle.

T-Mobile proposed a compromise: anonymous bidding would not be used in the AWS-1 auction unless the modified eligibility ratio fell below three, i.e., unless the eligibility of qualified bidders produced a mean of less than three bidders per license. The FCC adopted the compromise.

It is interesting that the AWS-1 auction had among its qualified bidders four which never placed a bid, and seven which bid only once. Given how narrowly the modified eligibility ratio reached 3.05, if these marginal bidders had not been present, the auction would have been anonymous. There was certainly the impression left that the auction rules were gamed by the introduction of "qualified" bidders whose presence was solely to ensure that a modified eligibility ratio of three was achieved so that the AWS-1 auction would not be anonymous. The vigor with which several incumbents opposed anonymous bidding raises the question of whether they had any hand in arranging the participation of these "ratio pumping" bidders in the auction. At the least, the AWS-1 auction experience suggested that "compromises" which introduce artificial conditions for implementation of anonymous bidding were an invitation for the rules to be gamed.

Anonymous bidding did not occur in the AWS-1 auction, and thus it provided a test of whose claims were the true: the incumbents or their opponents.

I. Major Incumbents Pursued a Tacitly-Collusive Strategy of Excluding Potentially Threatening New Entrants from Acquiring National Footprint in the AWS-1 Auction.

A. Focus of the Study.

Within days of the end of the AWS-1 auction industry analysts and public interest activists were mooting the fate of Wireless DBS LLC in the auction with speculations that the coalition of satellite television providers had been forced from the auction after failing to acquire any licenses in the face of opposition from a coalition of major incumbents. However, very little attention was paid to the specific dynamics of the interaction between incumbents and Wireless DBS LLC in the auction and no attempt was made to investigate whether a more general strategy of blocking new entrants who aspired to obtaining a national AWS-1 footprint had been pursued. This study focuses on identifying major incumbents, new entrants who were targeted for blocking by those incumbents, and the strategies used by those incumbents again targeted new entrants during bidding, evaluating the success of these blocking strategies, and recommending remedies for preventing such blocking strategies in future spectrum auctions.

B. A Broader Definition of Market Structure is Necessary for Analysis of the AWS-1 Auction.

It is necessary first to be clear about the market structure underlying the AWS-1 auction. The tendency to narrowly define this market as only wireless broadband provision obscures more than it illuminates, and it runs contrary to much current theorizing in industrial organization. The wireless broadband market is nested in a more general broadband provision market and not merely firms which have substantial pre-existing wireless broadband deployments. Firms with substantial pre-existing DSL and cable modem broadband deployments must be regarded as critically-positioned incumbents for the AWS-1 auction. It is precisely the extraordinary capitalization resources of these latter firms, mainly cable and telephone companies, and their ability to integrate wireless broadband delivery with their existing systems which had enormous effect on their ability to succeed in the AWS-1 auction. This study, therefore, treats such bidders as incumbents.

C. The Absence of Anonymous Bidding in the AWS-1 Auction Facilitated Identification of New Entrants and the Incumbents' Blocking Strategy.

The absence of anonymous bidding in the AWS-1 auction afforded opportunities for incumbents to identify new entrants who represented a serious competitive threat and block them by concentrating collectively on rapidly outbidding them on licenses necessary for acquisition of a national AWS footprint. These tactics, for example, placed the principal DBS bidder, Wireless DBS LLC, in the AWS-1 auction at a considerable disadvantage. Wireless DBS LLC was unable to acquire a national footprint at auction, particularly in the Cellular Market Area (CMA) and Regional Economic Area Grouping (REAG) licenses, in large part because incumbent telephone and cable broadband providers were able to identify and block Wireless DBS LLC bids. Other new entrants such as Atlantic Wireless LP, Antares Holdings LLC, Dolan Family Holdings LLC, and NTELOS Inc. were also blocked. Atlantic Wireless obtained only 12.20% of the licenses upon which it bid; Antares Holdings and Dolan Family Holdings, like Wireless DBS, obtained no licenses. NTELOS Inc. obtained 38.89% of the licenses it sought, but it is, as shown below, a special case. Wireless DBS LLC was sufficiently blocked that it effectively withdrew from the auction after the eleventh round. Dolan Family Holdings LLC withdrew after the twentieth round. Antares Holdings LLC withdrew after the thirtieth round. Atlantic Wireless LP was able to persevere through round ninety-seven.

Notable among incumbents participating in such blocking behavior were T-Mobile License LLC, SpectrumCo LLC, and Cingular AWS LLC. Barat Wireless LP,[6] MetroPCS AWS LLC, Denali Spectrum License LLC, and Cricket Licensee (Reauction),[7] Inc. also engaged in this blocking behavior. These incumbents obtained significant percentages of the licenses on which they bid: T-Mobile obtained 41.52% of the licenses on which it bid, SpectrumCo 60.89%, Cingular AWS 22.07%, Barat Wireless 25.76%, and Cricket Licensee (Reauction) 37.64%,. MetroPCS AWS and Denali Spectrum acquired significantly less of the licenses on which they bid – 12.12% and 5.88%, respectively. These two incumbents faced significant challenge from other incumbents as a result of intersecting bidding strategies. Although a major incumbent, Verizon chose less frequently to engage in blocking new entrant acquisition of national footprint; it still obtained 61.90% of the licenses on which it bid.

D. Identifying Major Incumbents and Targeted New Entrants.

For purposes of this study, a major incumbent was defined as a bidder owned by firm(s) with significant, pre-existing, national or near-national broadband deployment, whether wireless or landline. A targeted new entrant was defined as an entrant which bid on ten or more licenses and which was challenged by two or more incumbents at a rate at

[6] Barat Wireless LP is primarily owned by U.S. Cellular Corporation.

[7] Denali Spectrum License LLC and Cricket Licensee (Reauction) are primarily owned by LEAP International Wireless, Inc.

least two standard deviations higher than the mean rate at which each incumbent challenged all bidders. A challenged incumbent was defined as an incumbent which was challenged by two or more incumbents at a rate at least two standard deviations higher than the mean rate at which each incumbent challenged all bidders. Table 1 shows the rate of challenge on licenses by incumbents in standard deviations from the mean number of challenges to all bidders by each incumbent:[8]

Table 1.
Rate of Challenge by Incumbents in Standard Deviations from the Mean of Each Incumbent

	Challenging Incumbents							
Challenged Bidders	**T-Mobile License LLC**	**SpectrumCo LLC**	**Cingular AWS LLC**	**Cricket Licensee (Reauction), Inc.**	**Barat Wireless L.P.**	**Cellco Partnership d/b/a Verizon Wireless**	**Denali Spectrum License LLC**	**MetroPCS AWS LLC**
18th Street Spectrum LLC	0.5769	0.1334	-0.1065	0.0313	1.4360	-0.2013	-0.1858	-0.2559
3 Rivers Telephone Cooperative Inc	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
ACS Wireless License Sub Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Advanced Communications Technology Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Agri-Valley Communications	0.2794	-0.4724	-0.0820	-0.5292	-0.3930	-0.2013	-0.1858	0.3565
Alenco Communications Inc.	0.2794	-0.4724	-0.4508	0.6719	-0.3930	-0.2013	-0.1858	-0.2559
Allcom Communications Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
American Cellular Corporation	0.4686	0.2937	0.3298	0.3751	0.5640	-0.2013	-0.0554	-0.1063
Antares Holdings LLC	1.7670	**2.7728**	**3.0532**	**2.0231**	0.0969	-0.2013	0.6156	**3.1122**
Arapahoe Telephone Company d/b/a ATC Communication	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
AST Telecom LLC	-0.4644	4.0708	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Atlantic Seawinds Communications LLC	4.7421	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Atlantic Wireless LP	**2.1600**	**2.6672**	**2.7818**	**2.0341**	1.6144	0.5377	0.2703	-0.2559
AWS Wireless Inc.	1.1594	0.8897	0.8999	0.9172	0.4074	0.1035	0.0173	0.4859
Aztech Communications Inc.	-0.4644	-0.4724	-0.4508	**3.6746**	-0.3930	-0.2013	-0.1858	-0.2559
Barat Wireless LP	1.5078	1.5927	**2.1311**	-0.5292	-	0.7169	0.4941	0.3936
Beehive Telephone Company Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
BEK Communications Cooperative	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Bend Cable Communications LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Big Bend Telecom LTD	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Big River Telephone Company LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559

[8] In Table 1 **boldfaced** numbers are rates of challenge two or more standard deviations from the mean of the challenging incumbent; targeted new entrants are **boldfaced** and challenged incumbents are *italicized*.

Table 1. (Continued)
Rate of Challenge by Incumbents in Standard Deviations from the Mean of Each Incumbent

Challenging Incumbents

Challenged Bidders	T-Mobile License LLC	SpectrumCo LLC	Cingular AWS LLC	Cricket Licensee (Reauction), Inc.	Barat Wireless L.P.	Cellco Partnership d/b/a Verizon Wireless	Denali Spectrum License LLC	MetroPCS AWS LLC
Blackfoot Telephone Cooperative Inc	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Blue Valley Tele-Communications Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Bluestreak Wireless LLC	0.1141	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
BPS Telephone Company	4.7421	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Breda Telephone Corp.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
C&W Enterprises Inc.	-0.4644	-0.4724	-0.4508	-0.3136	-0.3930	-0.2013	-0.1858	-0.2559
Cable One Inc	-0.4644	-0.4724	-0.4508	-0.5292	-0.0413	-0.2013	-0.1858	-0.2559
Cal-Ore Telephone Co.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Carolina Personal Communications Inc.	4.7421	0.6634	0.8402	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Carolina West Wireless Inc	0.8372	-0.1928	0.6084	0.1014	0.9787	-0.2013	-0.1858	0.3157
Cavalier Wireless LLC	0.7905	1.4747	-0.4508	0.5918	-0.0413	1.0418	-0.1858	-0.2559
CCTN Biddng Consortium	-0.4644	1.9074	1.7623	-0.5292	-0.3930	-0.2013	1.4170	0.5606
Cellco Partnership d/b/a Verizon Wireless	1.0232	1.9074	0.5174	1.0723	0.9134	-	-0.1858	-0.2559
Cellular South Licenses Inc.	0.8792	0.3795	1.0680	1.7041	0.0357	-0.2013	-0.1858	0.2484
Centennial Michiana License Company LLC	0.7607	0.0621	-0.4508	-0.2819	-0.3930	-0.2013	-0.1858	1.3516
Central Texas Telephone Investments LP	-0.4644	-0.4724	-0.4508	-0.2664	-0.3930	-0.2013	-0.1858	-0.2559
Central Utah Telephone Company	-0.4644	-0.4724	0.0583	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
CenturyTel Broadband Wireless LLC	0.2689	0.5515	**3.2376**	0.6550	0.9594	1.9324	-0.1858	-0.2559
Chariton Valley Communication Corporation Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Chequamegon Communications Cooperative Inc	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Chester Telephone Company	-0.4644	-0.4724	-0.4508	3.6746	-0.3930	-0.2013	-0.1858	-0.2559
Churchill County Telephone d/b/a CC Communications	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Cincinnati Bell Wireless LLC	0.5369	1.4498	0.5422	0.7643	-0.3930	-0.2013	-0.1858	1.8362
Cingular AWS LLC	1.8524	**2.3318**	-	1.8845	1.7729	1.1035	0.6731	-0.2559
City of Ketchikan dba Ketchikan Public Utilities	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Clay County Rural Telephone Cooperative Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Clinker LLC	-0.4644	-0.4724	-0.4508	**3.6746**	-0.3930	-0.2013	-0.1858	-0.2559
Coleman County Telecommunications LTD	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Command Connect LLC	-0.4644	1.1178	-0.4508	0.9422	-0.3930	**8.8884**	-0.1858	0.1728
Comporium Wireless LLC	2.1389	-0.4724	-0.4508	1.5727	-0.3930	-0.2013	-0.1858	-0.2559
Craw-Kan Telephone Cooperative Inc	-0.4644	-0.4724	1.9053	0.3116	-0.3930	-0.2013	-0.1858	-0.2559
Cricket Licensee (Reauction) Inc	1.4955	1.6524	-0.4508	-	1.4325	0.7204	0.4114	0.9502
Cross Telephone Company	-0.4644	-0.4724	-0.4508	0.3116	**2.3505**	-0.2013	-0.1858	-0.2559
CTC Telcom Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559

Table 1. (Continued)
Rate of Challenge by Incumbents in Standard Deviations from the Mean of Each Incumbent

Challenging Incumbents

Challenged Bidders	T-Mobile License LLC	SpectrumCo LLC	Cingular AWS LLC	Cricket Licensee (Reauction), Inc.	Barat Wireless L.P.	Cellco Partnership d/b/a Verizon Wireless	Denali Spectrum License LLC	MetroPCS AWS LLC
Dakota Wireless Group LLC	-0.4644	-0.4724	0.3571	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Daredevil Commuinications LLC	0.4565	0.9184	**4.4093**	0.5575	0.1669	0.0048	-0.1095	0.3857
Denali Spectrum License LLC	1.0669	**3.5363**	-0.4508	**2.9328**	**2.8346**	**5.1456**	-	**5.2915**
Diller Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	**6.4657**	-0.2013	-0.1858	-0.2559
Dolan Family Holdings LLC	1.9386	1.6245	**3.1242**	1.0877	-0.3930	**2.1294**	**4.1295**	**3.7010**
Ellijay Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
ETCOM LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Farmers Mutual Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Farmers Telecommunications Cooperative Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Fidelity Communications Company	-0.4644	-0.4724	-0.4508	-0.1470	-0.3930	-0.2013	-0.1858	-0.2559
FMTC Wireless Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
FTC Management Group Inc.	-0.4644	1.7992	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Graceba Total Communications Inc	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Grand River Communications Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Granite State Long Distance Inc.	**2.1389**	-0.4724	**2.1311**	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Green Hills Area Cellular Telephone Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Hancock Rural Telephone Corporation	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Hawaiian Telcom Communications Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Heart of Iowa Communications Cooperative	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Hemingford Cooperative Telephone Company	-0.4644	-0.4724	-0.4508	1.5727	0.5215	-0.2013	-0.1858	-0.2559
Hill Country Telephone Cooperative Inc	-0.4644	1.7992	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Horry Telephone Cooperative Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Innovative Communication Corporation	-0.4644	4.0708	-0.4508	-0.1088	-0.3930	-0.2013	-0.1858	-0.2559
Iowa Intelegra Consortium LLC	0.5769	-0.4724	0.5820	-0.5292	**3.0364**	-0.2013	-0.1858	-0.2559
Iowa Telecommunications Services Inc	-0.2474	0.6634	-0.0205	-0.5292	1.3217	-0.2013	-0.1858	-0.2559
James Valley	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Jefferson Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Kingdom Telephone Company	-0.4644	-0.4724	-0.4508	0.8721	-0.3930	-0.2013	-0.1858	-0.2559
KTC AWS Limited Partnership	-0.4644	-0.4724	-0.0536	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
La Ward Cellular Telephone Company Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
LCDW Wireless Limited Partnership	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Leaco Rural Telephone Cooperative Inc	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Ligtel Communications Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
LL License Holdings II LLC	0.0395	0.1139	0.8818	-0.2580	**2.7045**	-0.2013	-0.1858	-0.2559

Table 1. (Continued)
Rate of Challenge by Incumbents in Standard Deviations from the Mean of Each Incumbent

Challenging Incumbents

Challenged Bidders	**T-Mobile License LLC**	**SpectrumCo LLC**	**Cingular AWS LLC**	**Cricket Licensee (Reauction), Inc.**	**Barat Wireless L.P.**	**Cellco Partnership d/b/a Verizon Wireless**	**Denali Spectrum License LLC**	**MetroPCS AWS LLC**
Lynch AWS Corporation	1.4881	0.6634	0.1947	-0.0037	1.3217	-0.2013	-0.1858	0.8158
MAC Wireless LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Manti Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
McDonald County Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Mediapolis Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
MetroPCS AWS LLC	**2.3755**	**3.1760**	**3.5394**	1.8275	0.6462	0.7169	1.6841	-
Midwest AWS Limited Partnership	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Mt. Vernon. Net Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
MTA Communications Inc.	0.2794	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	1.4170	-0.2559
MTPCS License Co. LLC	-0.4644	-0.1316	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Muenster Telephone Corp. of Texas	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Mutual Telephone Company	-0.4644	1.0420	-0.4508	-0.5292	**4.1795**	-0.2013	-0.1858	-0.2559
NEIT Wireless LLC	-0.4644	-0.4724	0.2869	-0.5292	**3.5263**	-0.2013	-0.1858	-0.2559
North Dakota Network Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Northeast Missouri Rural Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Northeast Nebraska Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	3.0364	-0.2013	-0.1858	-0.2559
Northern Iowa Communications Partners LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Northwest Missouri Cellular Limited Partnership	2.1389	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
NSIGHTTEL Wireless LLC	0.5273	-0.4724	0.7787	-0.5292	1.5666	-0.2013	-0.1858	-0.2559
NTELOS Inc.	0.4034	**2.5564**	**2.9918**	0.8721	-0.3930	-0.2013	-0.1858	-0.2559
Palmetto Rural Telephone Cooperative Inc.	1.2711	1.0420	**2.9918**	**2.2734**	-0.3930	-0.2013	-0.1858	-0.2559
Panhandle Telecommunication Systems Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Panora Telecommunications Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Partnership Wireless LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Paul Bunyan Rural Telephone Cooperative	-0.4644	-0.4724	0.1947	-0.0037	-0.3930	-0.2013	-0.1858	-0.2559
PCS Partners L.P.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Perry-Spencer Rural Telephone Coop. Inc. dba PSC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
PetroCom License Corporation	-0.4644	-0.4724	-0.4508	1.5727	-0.3930	-0.2013	-0.1858	-0.2559
Pine Cellular Phones Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Plains Cooperative Telephone Association Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Plateau Telecommunications Inc.	0.1141	-0.2200	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	0.2204
Public Service Wireless Services Inc.	-0.1751	1.2944	-0.1639	0.1715	-0.3930	-0.2013	-0.1858	-0.2559
Rainbow Telecommunications Association Inc.	-0.4644	-0.4724	-0.4508	**3.6746**	-0.3930	-0.2013	-0.1858	-0.2559

Table 1. (Continued)
Rate of Challenge by Incumbents in Standard Deviations from the Mean of Each Incumbent

Challenging Incumbents

Challenged Bidders	**T-Mobile License LLC**	**SpectrumCo LLC**	**Cingular AWS LLC**	**Cricket Licensee (Reauction), Inc.**	**Barat Wireless L.P.**	**Cellco Partnership d/b/a Verizon Wireless**	**Denali Spectrum License LLC**	**MetroPCS AWS LLC**
Red Rock Spectrum Holdings LLC	-0.4644	-0.1633	-0.3103	-0.3290	0.0736	-0.2013	-0.1858	-0.1976
Reservation Telephone Cooperative Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Roberts County Telephone Cooperative Association	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Rodriguez Marcos	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Ropir Communications Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Route 66 Wireless LLC	-0.4644	-0.4724	-0.4508	0.0714	-0.3930	-0.2013	-0.1858	-0.2559
Salina Spavinaw Telephone Co.Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Sandhill Communications LLC	-0.4644	-0.4724	-0.4508	**3.6746**	-0.3930	-0.2013	-0.1858	-0.2559
Shenandoah Mobile Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Shoreline Investments LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
SKT Inc.	-0.4644	-0.4724	0.5820	0.3116	**2.3505**	-0.2013	-0.1858	-0.2559
Smithville Spectrum LLC	-0.4644	-0.4724	-0.4508	0.8721	-0.3930	-0.2013	-0.1858	-0.2559
South #5 RSA Limited Partnership d/b/a Brazos Cell	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
South Slope Cooperative Telephone Company Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Southeastern Indiana Rural Telephone Coop. Inc.	-0.4644	-0.4724	-0.4508	1.5727	-0.3930	-0.2013	-0.1858	-0.2559
Space Data Spectrum Holdings LLC	0.0090	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	0.8341	-0.2559
SpectrumCo LLC	0.8219	-	**2.1615**	1.4985	1.2208	-0.2013	0.4741	1.5260
Spotlight Media Corp	0.2794	0.8257	0.5328	-0.1288	0.2602	-0.2013	-0.1858	-0.2559
St. Cloud Wireless Holdings LLC	**3.4405**	-0.4724	-0.4508	0.5218	-0.3930	-0.2013	-0.1858	-0.2559
Stayton Cooperative Telephone Company	-0.4644	-0.4724	-0.4508	0.5218	-0.3930	-0.2013	-0.1858	-0.2559
Telephone Electronics Coporation	-0.4644	-0.4724	0.1947	0.5218	-0.3930	-0.2013	-0.1858	-0.2559
The Chillicothe Telephone Company	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
The Pioneer Telephone Association Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
The S&T Telephone Cooperative Association Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
The Tri-County Telephone Association Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Three River Telco	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
T-Mobile License LLC	-	0.8324	1.5861	1.2309	1.2208	0.6375	0.3189	1.2274
Triad AWS Inc.	0.8372	1.6960	1.6617	1.0950	1.1658	0.4873	0.5791	1.3029
Tri-Valley Communications LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Union Telephone Company	-0.4644	-0.2748	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
United Telephone Mutual Aid Corp.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
United Wireless Communications Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Van Buren Wireless Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Vermont Telephone Company Inc.	0.0090	0.5372	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559

Table 1. (Continued)
Rate of Challenge by Incumbents in Standard Deviations from the Mean of Each Incumbent

	Challenging Incumbents							
Challenged Bidders	**T-Mobile License LLC**	**SpectrumCo LLC**	**Cingular AWS LLC**	**Cricket Licensee (Reauction), Inc.**	**Barat Wireless L.P.**	**Cellco Partnership d/b/a Verizon Wireless**	**Denali Spectrum License LLC**	**MetroPCS AWS LLC**
Volcano Internet Provider	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
West Carolina Piedmont Bidding Consortium	-0.4644	-0.4724	-0.4508	**2.2734**	-0.3930	-0.2013	-0.1858	-0.2559
West Central Communications LLC	-0.4644	-0.4724	0.5820	0.3116	-0.3930	-0.2013	-0.1858	-0.2559
West Central Telephone Association	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Western New Mexico Telephone Company Inc.	-0.4644	1.7992	**2.1311**	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Wheat State Telephone Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
Wireless DBS LLC	**2.7897**	**3.6449**	**3.9062**	**2.2296**	**2.1790**	**6.4266**	**3.6710**	**4.8345**
Wittenberg Telephone Company	0.4823	-0.4724	1.0984	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
WUE INC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
WWW Broadband LLC	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
XIT Leasing Inc.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559
XIT Telecommunication & Technology Ltd.	-0.4644	-0.4724	-0.4508	-0.5292	-0.3930	-0.2013	-0.1858	-0.2559

Two or more standard deviations from incumbent mean

Targeted New Entrant
Challenged Incumbent

Note that Wireless DBS LLC was challenged by all eight incumbents at a rate higher than two standard deviations from the mean of each incumbent; Atlantic Wireless LP, Antares Holdings LLC, and Dolan Family Holdings LLC were each challenged by four incumbents at a rate higher than two standard deviations from the mean of each incumbent. NTELOS Inc. was challenged by two incumbents at a rate higher than two standard deviations from the mean of each incumbent. No other new entrants were challenged at this rate by this array of incumbents.[9]

[9] Two incumbents, Denali Spectrum Holdings LLC and MetroPCS AWS LLC, were challenged by other incumbents at relatively high rates. This appears to have been a consequence of similarities in underlying bidding profile and an epiphenomenon of the smaller package of licenses each bid on in attempting to block the targeted new entrants.

As Table 2 indicates, a two-tailed t-test revealed that the difference between the rate at which incumbents challenged targeted new entrants and the rate at which they challenged all other bidders was statistically significant for all incumbents except Barat Wireless LP:

Table 2.
Results of Two-Tailed t-Test of Difference Between the Mean Rates of Challenge by Incumbents Against Targeted New Entrants and Against All Other Bidders[10]

	DF	T	P-value
T-Mobile License LLC	165	-4.3272	<0.0001
SpectrumCo LLC	165	-6.7935	<0.0001
Cingular AWS LLC	165	-8.6563	<0.0001
Cellco Partnership d/b/a Verizon Wireless	165	-4.1331	<0.0001
Denali Spectrum License LLC	165	-9.6572	<0.0001
MetroPCS AWS LLC	165	-7.8983	<0.0001
Cricket Licensee (Reauction), Inc.	165	-3.9016	0.0001
Barat Wireless LP	165	-1.4137	0.1593

No similar pattern of concentrated challenges by targeted new entrants was observed in the AWS-1. Table 3 shows the rate of challenge on licenses by targeted new entrants in standard deviations from the mean number of challenges to all bidders by each targeted new entrant[11]:

[10] A two-tailed t-test assesses whether the means of two groups are statistically different from each other. A *p* value of 0.0125 indicates that 1.25 times out of a hundred you would find a statistically significant difference between the means by random chance even if there was none, i.e., a 98.75 percent chance that the significant difference is genuine.

[11] In Table 3 **boldfaced** numbers are rates of challenge two or more standard deviations from the mean of the challenging targeted new entrant; challenged targeted new entrants are **boldfaced** and challenged incumbents are *italicized*.

Table 3.
Rate of Challenge by Targeted New Entrants in Standard Deviations from the Mean of Each Targeted New Entrant

	Challenging New Entrants				
Challenged Bidders	Antares Holdings LLC	Atlantic Wireless LP	Dolan Family Holdings LLC	NTELOS Inc.	Wireless DBS LLC
18th Street Spectrum, LLC	-0.1598	0.5881	-0.1396	0.6149	-0.2210
3 Rivers Telephone Cooperative Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
ACS Wireless License Sub, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Advanced Communications Technology, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Agri-Valley Communications	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Alenco Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Allcom Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
American Cellular Corporation	0.2746	0.5114	0.0019	0.2615	-0.0029
Antares Holdings LLC	**-**	**3.8223**	1.1643	-0.1263	0.1140
Arapahoe Telephone Company d/b/a ATC Communication	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
AST Telecom, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Atlantic Seawinds Communications, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Atlantic Wireless LP	1.3154	-	0.1572	0.1449	0.0840
AWS Wireless Inc.	0.3127	0.9278	0.0318	0.0527	0.0621
Aztech Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Barat Wireless LP	0.0019	1.5396	-0.1396	-0.1263	0.6317
Beehive Telephone Company, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
BEK Communications Cooperative	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Bend Cable Communications, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Big Bend Telecom, LTD	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Big River Telephone Company, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Blackfoot Telephone Cooperative Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Blue Valley Tele-Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Bluestreak Wireless LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
BPS Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Breda Telephone Corp.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
C&W Enterprises Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Cable One Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Cal-Ore Telephone Co.	-0.1598	6.5040	-0.1396	-0.1263	-0.2210
Carolina Personal Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Carolina West Wireless Inc	-0.1598	-0.3220	-0.1396	0.4296	-0.2210
Cavalier Wireless LLC	-0.0503	0.5881	-0.1396	-0.1263	-0.0286
CCTN Biddng Consortium	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Cellco Partnership d/b/a Verizon Wireless	-0.1598	0.6531	0.4399	-0.1263	**2.9056**
Cellular South Licenses, Inc.	-0.1598	0.1046	-0.1396	-0.1263	-0.2210
Centennial Michiana License Company LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Central Texas Telephone Investments, LP	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Central Utah Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
CenturyTel Broadband Wireless LLC	-0.1598	0.0625	-0.1396	-0.1263	-0.2210
Chariton Valley Communication Corporation, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210

Table 3. (Continued)
Rate of Challenge by Targeted New Entrants in Standard Deviations from the Mean of Each Targeted New Entrant

	Challenging New Entrants				
Challenged Bidders	**Antares Holdings LLC**	**Atlantic Wireless LP**	**Dolan Family Holdings LLC**	**NTELOS Inc.**	**Wireless DBS LLC**
Chequamegon Communications Cooperative Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Chester Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Churchill County Telephone d/b/a CC Communications	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Cincinnati Bell Wireless LLC	-0.1598	1.7783	-0.1396	-0.1263	-0.2210
Cingular AWS LLC	0.8105	**2.1928**	0.3845	0.1929	0.9908
City of Ketchikan dba Ketchikan Public Utilities	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Clay County Rural Telephone Cooperative, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Clinker LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Coleman County Telecommunications, LTD	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Command Connect LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Comporium Wireless, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Craw-Kan Telephone Cooperative Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Cricket Licensee (Reauction) Inc	0.5301	1.6245	0.0918	0.0428	0.5280
Cross Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
CTC Telcom, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Dakota Wireless Group LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Daredevil Commuinications LLC	0.3484	0.5138	-0.1396	-0.0507	-0.2210
Denali Spectrum License LLC	*1.0959*	*1.6856*	***3.4399***	*-0.1263*	***5.8483***
Diller Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Dolan Family Holdings LLC	**2.3033**	1.2532	-	-0.1263	**4.1082**
Ellijay Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
ETCOM, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Farmers Mutual Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Farmers Telecommunications Cooperative, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Fidelity Communications Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
FMTC Wireless, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
FTC Management Group, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Graceba Total Communications Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Grand River Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Granite State Long Distance, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Green Hills Area Cellular Telephone, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Hancock Rural Telephone Corporation	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Hawaiian Telcom Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Heart of Iowa Communications Cooperative	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Hemingford Cooperative Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Hill Country Telephone Cooperative Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210

Table 3. (Continued)
Rate of Challenge by Targeted New Entrants in Standard Deviations from the Mean of Each Targeted New Entrant

	Challenging New Entrants				
Challenged Bidders	Antares Holdings LLC	Atlantic Wireless LP	Dolan Family Holdings LLC	NTELOS Inc.	Wireless DBS LLC
Horry Telephone Cooperative, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Innovative Communication Corporation	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Iowa Intelegra Consortium LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Iowa Telecommunications Services Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
James Valley	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Jefferson Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Kingdom Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
KTC AWS Limited Partnership	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
La Ward Cellular Telephone Company, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
LCDW Wireless Limited Partnership	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Leaco Rural Telephone Cooperative Inc	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Ligtel Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
LL License Holdings II, LLC	-0.1598	-0.1019	-0.1396	-0.1263	-0.2210
Lynch AWS Corporation	-0.1598	1.3845	-0.1396	-0.1263	-0.2210
MAC Wireless, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Manti Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
McDonald County Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Mediapolis Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
MetroPCS AWS, LLC	1.6191	1.8499	0.9668	-0.1263	**2.4793**
Midwest AWS Limited Partnership	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Mt. Vernon. Net, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
MTA Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	1.1190
MTPCS License Co., LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Muenster Telephone Corp. of Texas	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Mutual Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
NEIT Wireless, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
North Dakota Network Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Northeast Missouri Rural Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Northeast Nebraska Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Northern Iowa Communications Partners, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Northwest Missouri Cellular Limited Partnership	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
NSIGHTTEL Wireless, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
NTELOS Inc.	-0.1598	**4.2286**	-0.1396	-	-0.2210
Palmetto Rural Telephone Cooperative, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Panhandle Telecommunication Systems, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Panora Telecommunications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Partnership Wireless LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Paul Bunyan Rural Telephone Cooperative	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210

Table 3. (Continued)
Rate of Challenge by Targeted New Entrants in Standard Deviations from the Mean of Each Targeted New Entrant

	Challenging New Entrants				
Challenged Bidders	**Antares Holdings LLC**	**Atlantic Wireless LP**	**Dolan Family Holdings LLC**	**NTELOS Inc.**	**Wireless DBS LLC**
PCS Partners, LP	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Perry-Spencer Rural Telephone Coop., Inc. dba PSC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
PetroCom License Corporation	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Pine Cellular Phones, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Plains Cooperative Telephone Association, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Plateau Telecommunications, Inc.	-0.1598	0.0572	-0.1396	-0.1263	-0.2210
Public Service Wireless Services, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Rainbow Telecommunications Association, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Red Rock Spectrum Holdings, LLC	-0.1598	-0.2756	-0.1396	-0.1263	-0.2210
Reservation Telephone Cooperative, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Roberts County Telephone Cooperative Association	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Rodriguez, Marcos	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Ropir Communications, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Route 66 Wireless, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Salina Spavinaw Telephone Co.Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Sandhill Communications, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Shenandoah Mobile Company	-0.1598	-0.3220	-0.1396	**6.5449**	-0.2210
Shoreline Investments LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
SKT, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Smithville Spectrum, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
South #5 RSA Limited Partnership d/b/a Brazos Cell	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
South Slope Cooperative Telephone Company, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Southeastern Indiana Rural Telephone Coop., Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Space Data Spectrum Holdings, LLC	-0.1598	-0.3220	-0.1396	-0.1263	**2.3371**
SpectrumCo LLC	0.6773	1.9533	0.1467	-0.0391	0.8457
Spotlight Media Corp	0.3484	0.6531	-0.1396	0.4031	0.6723
St. Cloud Wireless Holdings, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Stayton Cooperative Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Telephone Electronics Coporation	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
The Chillicothe Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
The Pioneer Telephone Association, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
The S&T Telephone Cooperative Association, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
The Tri-County Telephone Association, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Three River Telco	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
T-Mobile License LLC	0.4311	1.1896	0.3657	-0.0109	0.6553

Table 3. (Continued)
Rate of Challenge by Targeted New Entrants in Standard Deviations from the Mean of Each Targeted New Entrant

	Challenging New Entrants				
Challenged Bidders	**Antares Holdings LLC**	**Atlantic Wireless LP**	**Dolan Family Holdings LLC**	**NTELOS Inc.**	**Wireless DBS LLC**
Triad AWS, Inc.	1.0531	**2.0050**	0.1370	-0.1263	0.4185
Tri-Valley Communications, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Union Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
United Telephone Mutual Aid Corp.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
United Wireless Communications Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Van Buren Wireless, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Vermont Telephone Company, Inc.	**2.2120**	0.4364	-0.1396	-0.1263	-0.2210
Volcano Internet Provider	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
West Carolina Piedmont Bidding Consortium	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
West Central Communications LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
West Central Telephone Association	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Western New Mexico Telephone Company, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Wheat State Telephone, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
Wireless DBS LLC	0.1737	0.5312	**2.1423**	-0.1263	-
Wittenberg Telephone Company	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
WUE INC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
WWW Broadband, LLC	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
XIT Leasing, Inc.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210
XIT Telecommunication & Technology, Ltd.	-0.1598	-0.3220	-0.1396	-0.1263	-0.2210

Challenged Targeted New Entrant
Challenged Incumbent

One targeted new entrant, Dolan Family Holdings LLC, was challenged by two other targeted new entrants – Antares Holdings LLC and Wireless DBS LLC – at a rate higher than two standard deviations from the mean of those new entrants. Atlantic Wireless LP also came into conflict with two other targeted new entrants – Antares Holdings LLC and NTELOS Inc. Only one incumbent, Denali Spectrum License LLC, was challenged by two targeted new entrants – Antares Holdings LLC and Wireless DBS LLC -- at a rate higher than two standard deviations from the mean of those new entrants. None of these cases were statistically significant. The lack of parity to the incumbents in concentrated challenges by targeted new entrants militates against the incumbent challenges being solely the consequences of similar underlying bidding strategy of the bidders involved.

II. Examination of the Bidding Profiles of Targeted New Entrants Discloses the Exclusionary Bidding Strategy of Major Incumbents.

It may certainly be argued that the challenges of the incumbents to the targeted new entrants is simply an epiphenomenon of the fact that the spectrum at issue was highly sought by all bidders. This is not, in fact, true, since the bidding on the relevant spectrum involved in the main only incumbents and targeted new entrants. Furthermore, this argument seems to miss the point: most highly-prized licenses in the AWS-1 auction were highly-prized precisely because they offered complementarities to any bidder seeking national footprint or seeking to block others from attaining that footprint. In order to determine exactly what underlies the pattern of concentrated challenges by incumbents it is necessary to examine the bidding profiles of the targeted new entrants in some detail.

A. Antares Holdings LLC.

Table 4 presents the bidding profile of Antares Holdings LLC:

Table 4.
Bidding Profile of Antares Holdings LLC

	BEA		CMA	REAG			
	B Block	**C Block**	**A Block**	**D Block**	**E Block**	**F Block**	**Total**
No. of Licenses Sought	6	15	6	1	0	0	28
States/Areas Covered	DC, DE, MA, MD, NH, NJ, NY, PA, RI, VA, VT, WV	CT, DC, DE, FL, IA, IL, IN, MA, MD, MN, MO, NH, NJ, NY, PA, RI, TX, VA, VT, WI, WV	CT, MA, NH, NJ, NY, RI	PR, USVI	-	-	-

Table 4. (Continued)
Bidding Profile of Antares Holdings LLC

	BEA		CMA	REAG			
	B Block	**C Block**	**A Block**	**D Block**	**E Block**	**F Block**	**Total**
Population of Coverage Area	27,347,178	90,548,766	8,244,935	3,917,222	0	0	130,058,101
Challenging Incumbents (No. of Licenses Challenged)	Cingular AWS LLC (3), Cricket License (Reauction) Inc. (4), MetroPCS AWS LLC (3), SpectrumCo LLC (6), T-Mobile License LLC (3)	Barat Wireless LP (1), Cingular AWS LLC (14), Cricket License (Reauction) Inc. (11), Denali Spectrum License LLC (2), MetroPCS AWS LLC (7), SpectrumCo LLC (13),T-Mobile License LLC (7)	Cricket License (Reauction) Inc. (2), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (6)	Cingular AWS LLC (1)	-	-	-
States/Areas Covered by Challenged Licenses	DC, DE, MA, MD, NH, NJ, NY, PA, RI, VA, VT WV	CT, DC, DE, FL, IA, IL, IN, MA, MD, MN, MO, NH, NJ, NY, PA, RI, TX, VA, VT, WI, WV	CT, MA, NH, NJ, NY, RI	PR, USVI	-	-	-
Population of Coverage Area of Challemnged Licenses	27,347,178	90,548,766	8,244,935	3,917,222	-	-	130,058,101

Antares Holdings LLC aimed at creating a base in the eastern half of the U.S. and Texas with a combination of six BEA B Block and fifteen C Block licenses, six CMA A Block licenses, and one REAG D Block license, covering nineteen states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands with a coverage population of 130,058,101. Antares Holdings LLC is owned by a major investor in Northcoast Communications LLC, which held a PCS footprint roughly covering the same area as the licenses sought in the AWS-1 auction. Fifty of these PCS licenses were sold to Verizon for $750,000,000 in 2003. Acquistion of the AWS licenses would have recreated a strong regional base in an area where Northcoast had dominated as a PCS provider and from which to acquire national AWS footprint in future auctions. Five incumbents challenged for the BEA B Block licenses, seven for the C Block licences, and four for the CMA A Block licenses. One incumbent challenged for the REAG D Block license. SpectrumCo LLC acquired the six BEA B Block Licenses. Cingular AWS LLC acquired six of the BEA C Block licenses, SpectrumCo LLC three, Crick Licensee (Reauction) Inc. two, T-Mobile License LLC one, and non-incumbents Vermont Telephone Company Inc., American Cellular Corporation, and Daredevil Communications LLC one each. Cingular AWS LLC acquired the REAG D Block license. A number of incumbents did not persevere on these licenses beyond the withdrawal of Antares Holdings LLC and other non-incumbents which were not seeking the same footprint went largely unchallenged. The appearance of a concerted effort by incumbents to block Antares Holdings LLC is difficult to avoid.

B. Atlantic Wireless LP.

Table 5 provides the bidding profile of Atlantic Wireless LP:

Table5.
Bidding Profile of Atlantic Wireless LP

	BEA		CMA	REAG			
	B Block	C Block	A Block	D Block	E Block	F Block	Total
No. of Licenses Sought	34	48	39	0	1	1	123

Table5. (Continued)
Bidding Profile of Atlantic Wireless LP

	BEA		CMA	REAG			
	B Block	C Block	A Block	D Block	E Block	F Block	Total
States/Areas Covered	AZ, CA, CO, DE, FL, HI, ID, IL, IN, KS, KY, MA, MD, ME, MI, MO, NC, NE, NH, NM, NV, NY, OH, OR, PA, RI, SC, TX, UT, VA, VT, WA, WI, WV	AL, AR, AZ, CA, CO, DC, DE, FL, GA, HI, IA, ID, IL, IN, KS, KY, MA, MD, MI, MN, MO, MS, NC, NE, NH, NJ, NV, OH, OK, OR, PA, RI, SC, TN, TX, UT, VA, VT, WA, WI, WV	AR, CA, CO, CT, FL, GA, HI, IL, IN, KS, KY, MA, MD, MI, MN, MO, MS, NC, NH, NJ, NV, OH, OR, PA, RI, TN, TX, UT, VA, WA, WI	-	HI	Northeast	-
Population of Coverage Area	72,544,094	161,946,246	89,491,506	-	1,211,537	50,058,090	375,251,473
Challenging Incumbents (No. of Licenses Challenged)	Barat Wireless LP (6), Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (18), Cricket Licensee (Reauction) Inc. (20), MetroPCS AWS LLC (4), SpectrumCo LLC (32), T-Mobile License LLC (5)	Barat Wireless LP (6), Cingular AWS LLC (35), Cricket Licensee (Reauction) Inc. (24), Denali Spectrum Holdings LLC (2), MetroPCS AWS LLC (10), SpectrumCo LLC (48), T-Mobile License LLC (20)	Barat Wireless LP (6), Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (25), Cricket Licensee (Reauction) Inc. (29), Denali Spectrum Holdings LLC (2), MetroPCS AWS LLC (7), SpectrumCo LLC (9), T-Mobile License LLC (39)	-	T-Mobile License LLC (1)	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1), Cricket Licensee (Reauction) Inc. (1), Denali Spectrum Holdings LLC (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	-
States/Areas Covered by Challenged Licenses	AZ, CA, CO, DE, FL, HI, ID, IL, IN, KS, KY, MA, MD, ME, MI, MO, NC, NE, NH, NM, NV, NY, OH, OR, PA, RI, SC, TX, UT, VA, VT, WA, WI, WV	AL, AR, AZ, CA, CO, DC, DE, FL, GA, HI, IA, ID, IL, IN, KS, KY, MA, MD, MI, MN, MO, MS, NC, NE, NH, NJ, NV, OH, OK, OR, PA, RI, SC, TN, TX, UT, VA, VT, WA, WI, WV	AR, CA, CO, CT, FL, GA, HI, IL, IN, KS, KY, MA, MD, MI, MN, MO, MS, NC, NH, NJ, NV, OH, OR, PA, RI, TN, TX, UT, VA, WA, WI	-	HI	Northeast	-

Table5. (Continued)
Bidding Profile of Atlantic Wireless LP

	BEA		CMA	REAG			
	B Block	C Block	A Block	D Block	E Block	F Block	Total
Population of Coverage Area of Challemnged Licenses	72,544,094	161,946,246	89,491,506	-	1,211,537	50,058,090	375,251,473

Atlantic Wireless LP sought 34 BEA B Block licenses, forty-eight C Block licenses, thirty-nine CMA A Block licenses, one REG E Block license and one REAG F Block license, covering forty-three states, the District of Columbia, and the northeast region with a covered population of 375,251,473. Atlantic Wireless L.P. is primarily owned by Charles C. Townsend, founder of Aloha Partners L.P. which dominated two earlier lower700 MHz band auctions with seventy-seven 700 MHz licenses (auction 44) and eighty-nine 700 MHz licenses (auction 49), owning 12MHz of spectrum covering sixty percent of the United States -- including all of the top 10 markets -- and eighty-four percent of the population in the top 40 markets. Atlantic Wireless was a major contender for establishing a national AWS footprint. Seven incumbents challenged for the BEA B and C Block licenses, eight for the CMA A Block licenses, one for the REAG E Block license, and seven for the REAG F Block license. Atlantic Wireless LP obtained two BEA B Block licenses. SpectrumCo LLC obtained twenty-four BEA B Block licenses, Barat Wireless LP, Cellco Partnership d/b/a Verizon Wireless, Cingular AWS LLC, Cricket Licensee (Reauction) Inc., and non-incumbents American Cellular Corporation and Cavalier Wireless LLC one each. Atlantic Wireless secured twelve BEA C Block licenses. Cingular AWS LLC obtained 13 BEA C Block licenses, Cricket Licensee (Reauction) Inc. nine, T-Mobile License LLC five, SpectrumCO LLC three, MetroPCS

AWS LLC two, and non-incumbents Cavalier Wireless LLC, Cincinnati Bell Wireless LLC, Daredevil Communications LLC, and Lynch AWS Corporation one each. Atlantic Wireless LP won one CMA A Block license. T-Mobile License LLC secured seventeen CMA A Block Licenses, Cricket Licensee (Reauction) Inc. eight, Cingular AWS LLC five, Barat Wireless LP one, and non-incumbents AWS Wireless Inc. six and Cincinnati Bell Wireless LLC one. T-Mobile License LLC and Cellco Partnership d/b/a Verizon Wireless obtained the REAG E and F Block licenses respectively. The swarm of incumbents to challenge Atlantic Wireless LP for all but the REAG E Block license, the failure of many incumbents to persevere when Atlantic Wireless LP ceased bidding on a license, and the acquisition of portions of this spectrum by non-incumbents who did not present a threatening profile argue strongly for incumbent behavior being an attempt to block acquisition of a national AWS footprint by Atlantic Wireless LP. Atlantic Wireless LP did manage to salvage a more restricted position in the face of this onslaught than did Wireless DBS LLC, despite Wireless DBS LLC's better capitalization; this is likely a consequence of Atlantic Wireless LP's more aggressive bidding strategy and willingness to engage in retaliatory bidding.

C. Dolan Family Holdings LLC.

Table 6 provides the bidding profile for Dolan Family Holdings LLC:

Table 6.
Bidding Profile of Dolan Family Holdings LLC

	BEA		**CMA**	**REAG**			
	B Block	**C Block**	**A Block**	**D Block**	**E Block**	**F Block**	**Total**
No. of Licenses Sought	1	1	8	1	1	1	13
States/Areas Covered	CT, NJ, NY, MA, PA, VT	CT, NJ, NY, MA, PA, VT	CT, NJ, NY	Northeast	Northeast	Northeast	-

Table 6. (Continued)
Bidding Profile of Dolan Family Holdings LLC

	BEA		CMA	REAG			
	B Block	**C Block**	**A Block**	**D Block**	**E Block**	**F Block**	**Total**
Population of Coverage Area	25,712,577	25,712,577	19,658,795	50,058,090	50,058,090	50,058,090	221,258,219
Challenging Incumbents (No. of Licenses Challenged)	Cingular AWS LLC (1), Cricket Licensee (Reauction) Inc. (1), Denali Spectrum License LLC (1), SpectrumCo LLC (1)	Cingular AWS LLC (1), Cricket Licensee (Reauction) Inc. (1), Denali Spectrum License LLC (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	Cingular AWS LLC (4), Cricket Licensee (Reauction) Inc. (2), Denali Spectrum License LLC (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (8)	Cingular AWS LLC (1), Denali Spectrum License LLC (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	Cingular AWS LLC (1), Denali Spectrum License LLC (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1)	-
States/Areas Covered by Challenged Licenses	CT, NJ, NY, MA, PA, VT	CT, NJ, NY, MA, PA, VT	CT, NJ, NY	Northeast	Northeast	Northeast	-
Population of Coverage Area of Challenged Licenses	25,712,577	25,712,577	19,658,795	50,058,090	50,058,090	50,058,090	221,258,219

Dolan Family Holdings LLC aimed at creating a regional base in the northeast with a combination of eight CMA A Block licenses and one each of the BEA B and C Block and the REAG D, E, and F Block licenses, covering six states and the northeast region with a coverage population of 221,258,219. The licenses sought by Dolan Family Holdings LLC represented a strategy of acquiring dominance in the most potentially lucrative region to create a base from which to seek a future national footprint, since the principal stakeholders in Dolan Family Holdings LLC also control Cablevision, the dominant cable provider in New York City. At every turn it was faced by a swarm of concentrated challenges by incumbents: total of four incumbents for the one BEA B

Block license, five for the one BEA C Block license, six for the CMA A Block licenses, five for the REAG D and E Block licenses, and two for the REAG F Block license. SpectrumCo LLC took the BEA B Block license, MetroPCS AWS the BEA C Block license. T-Mobile License LLC took four of the CMA A Block licenses and Cingular AWS LLC one, while non-incumbents American Cellular Corporation took two and AWS Wireless Inc. took one, respectively. MetroPCS AWS LLC took the REAG D Block license, T-Mobile License LLC took the E Block, and Verizon Wireless the F Block. The majority of incumbents did not persevere on these licenses beyond the withdrawal of Dolan Family Holdings LLC and other non-incumbents which were not seeking the same footprint went largely unchallenged. It is difficult to see how these patterns are explainable as anything but a successful, systematic attempt to block Dolan Family Holdings LLC.

D. NTELOS Inc.

Table 7 provides the bidding profile of NTELOS Inc.:

Table 7.
Bidding Profile of NTELOS Inc.

	BEA		**CMA**	**REAG**			
	B Block	**C Block**	**A Block**	**D Block**	**E Block**	**F Block**	**Total**
No. of Licenses Sought	0	3	15	0	0	0	18
States/Areas Covered	-	KY, NC, OH, VA, WV	KY, NC, OH, VA, WV	-	-	-	-
Population of Coverage Area	-	4,368,260	4,816,268	-	-	-	9,184,528
Challenging Incumbents (No. of Licenses Challenged)	-	Cingular AWS LLC (2), Cricket Licensee (Reauction) Inc. (1), SpectrumCo LLC (2)	Cingular AWS LLC (4), Cricket Licensee (Reauction) Inc. (3), T-Mobile License LLC (3)	-	-	-	-

Table 7. (Continued)
Bidding Profile of NTELOS Inc.

	BEA		CMA	REAG			
	B Block	**C Block**	**A Block**	**D Block**	**E Block**	**F Block**	**Total**
States/Areas Covered by Challenged Licenses	-	NC, VA	NC, VA	-	-	-	-
Population of Coverage Area of Challemnged Licenses	-	3,168,887	2,637,570	-	-	-	5,806,457

NTELOS Inc. is a classic example of a bidder with the bad luck to be in the wrong place at the wrong time. NTELOS Inc. aimed at constructing a Virginia-based network with overlap into neighboring states: three BEA C Block licenses and fifteen CMA A Block licenses, covering Virginia and parts of four other states with a coverage population of 9,184,528. NTELOS Inc. was challenged by three incumbents for two of the BEA C Block licenses and by three incumbents for four of the CMA C Block licenses. Cingular AWS LLC and Cricket Licensee (Reauction) Inc. each obtained one BEA C Block license, as did non-incumbent AWS Wireless Inc. Cingular AWS LLC obtained two CMA A Block licenses and Cricket Licensee (Reauction) Inc. one, while non-incumbents American Cellular Corporation and AWS Wireless Inc. took four and one, respectively. NTELOS Inc. successfully obtained seven CMA A Block licenses. The challenging incumbents persevered to victory and NTELOS was faced by several better capitalized non-incumbents. It was simply NTELOS Inc.'s misfortune that its bidding profile intersected those of several incumbents. There is no evidence of a systematic blocking pattern in this case.

E. Wireless DBS LLC.

Table 8 provides the bidding profile of Wireless DBS LLC:

Table 8.
Bidding Profile of Wireless DBS LLC

	BEA		CMA	REAG			
	B Block	**C Block**	**A Block**	**D Block**	**E Block**	**F Block**	**Total**
No. of Licenses Sought	1	1	5	8	8	8	31
States/Areas Covered	CA, CT, MA, NJ, NY, PA, VT	CT, MA, NJ, NY, PA, VT	CA, DC, IL, MD, NY, NJ, PA, VA	Northeast, Southeast, Great Lakes, Mississippi Valley, Central, West, Alaska, Hawaii	Northeast, Southeast, Great Lakes, Mississippi Valley, Central, West, Alaska, Hawaii	Northeast, Southeast, Great Lakes, Mississippi Valley, Central, West, Alaska, Hawaii	-
Population of Coverage Area	34,824,383	25,712,577	69,648,766	281,421,906	281,421,906	281,421,906	974,451,444
Challenging Incumbents (No. of Licenses Challenged)	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1), Cricket Licensee (Reauction) Inc. (1), Denali Spectrum Holdings LLC (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1)	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1), Cricket Licensee (Reauction) Inc. (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1)	Cingular AWS LLC (5), Cricket licensee (Reauction) Inc. (5), Denali Spectrum Holdings LLC (2), MetroPCS AWS LLC (3), SpectrumCo LLC (5), T-Mobile License LLC (5)	Barat Wireless LP (2), Cingular AWS LLC (6), Cricket Licensee (Reauction) Inc. (3), Denali Spectrum Holdings LLC (2), MetroPCS AWS LLC (6), SpectrumCo LLC (7), T-Mobile License LLC (6)	Barat Wireless LP (2), Cingular AWS LLC (6), Cricket Licensee (Reauction) Inc. (5), Denali Spectrum Holdings LLC (3), MetroPCS AWS LLC (5), SpectrumCo LLC (7), T-Mobile License LLC (8)	Barat Wireless LP (2), Cingular AWS LLC (7), Cricket Licensee (Reauction) Inc. (6), Denali Spectrum Holdings LLC (3), MetroPCS AWS LLC (2), SpectrumCo LLC (7), T-Mobile License LLC (7)	-
States/Areas Covered by Challenged Licenses	CA, CT, MA, NJ, NY, PA, VT	CT, MA, NJ, NY, PA, VT	CA, DC, IL, MD, NY, NJ, PA, VA	Northeast, Southeast, Great Lakes, Mississippi Valley, Central, West, Alaska, Hawaii	Northeast, Southeast, Great Lakes, Mississippi Valley, Central, West, Alaska, Hawaii	Northeast, Southeast, Great Lakes, Mississippi Valley, Central, West, Alaska, Hawaii	-
Population of Coverage Area of Challemnged Licenses	34,824,383	25,712,577	69,648,766	281,421,906	281,421,906	281,421,906	974,451,444

Wireless DBS LLC presented the most complete attempt of any new entrant to establish a national AWS footprint, bidding on a BEA B Block license, a BEA C Block license, five CMA A Block licenses, and eight licenses in each of the REAG D, E, and F Blocks, covering ten states and eight regions with a coverage population of 974,451,444. An alliance of the two principal providers of DBS television, Wireless DBS LLC sought to gain the terrestrial assets necessary for a national AWS system. This attempt met with the strongest and most concentrated blocking attempt by the incumbents, as a round-by-round case study describes below. SpectrumCo LLC obtained the BEA B Block license and MetroPCS AWS LLC the C Block license. T-Mobile License LLC obtained three CMA A Block licenses and Cricket Licensee (Reauction) Inc. two. T-Mobile License LLC and MetroPCS AWS LLC obtained two REAG D Block licenses each, Cingular AWS LLC, Denali Spectrum Holdings LLC, SpectrumCo LLC, and non-incumbent Spotlight Media Corp. each one. T-Mobile License LLC won four REAG E Block licenses, Barat Wireless LP, Cingular AWS LLC, Cricket Licensee (Reauction) Inc., and non-incumbent American Cellular Corporation one each. Cellco Partnership d/b/a Verizon Wireless acquired four REAG F Block licenses, T-Mobile License LLC three, and non-incumbent MTA Communications Inc. one. The pattern of incumbent challenges, failure of many incumbents to persevere after Wireless DBS LLC ceased bidding, and the success of less well-capitalized non-incumbents who did not possess Wireless DBS LLC's threatening national footprint profile all militate for this case being a successful blocking action against a targeted new entrant. Wireless DBS LLC was routed by concerted incumbent action.

III. Effects of the Major Incumbents' Exclusionary Strategy.

The effects of this exclusionary strategy were striking, as Table 5 discloses:

Table 9.
Comparison of Incumbents to Targeted Non-Incumbent in the AWS-1 Auction

Incumbents	**Total No. of Licenses Bid On**	**% of Licenses Bid On PWB**	**Round of Last Bid**	**Upfront Payment (in $million)**
Barat Wireless, L.P.	66	25.76%	128	80.00
Cellco Partnership d/b/a Verizon Wireless	21	61.90%	135	383.34
Cingular AWS, LLC	209	22.97%	114	500.00
Cricket Licensee (Reauction), Inc.	263	37.64%	115	255.00
Denali Spectrum License LLC	17	5.88%	109	50.00
MetroPCS AWS, LLC	66	12.12%	108	200.00
SpectrumCo LLC	225	60.89%	121	637.71
T-Mobile License LLC	289	41.52%	149	583.52
Mean	144.50	33.59%	122.38	336.20
Targeted Non-Incumbents				
Antares Holdings, LLC	28	0.00%	30	21.00
Atlantic Wireless, L.P.	123	12.20%	97	52.00
Dolan Family Holdings, LLC	13	0.00%	20	149.98
NTELOS Inc.	18	38.89%	104	2.66
Wireless DBS LLC	32	0.00%	11	972.55
Mean	42.8	10.22%	52.4	239.64

Incumbents who targeted new entrants did more than three times better on average at acquiring sought licenses than the targeted new entrants and they were able to persist in the auction on average more than twice as long than the targeted new entrants. Three of the new entrants -- Antares Holdings LLC, Dolan Family Holdings LLC, and Wireless DBS LLC – were excluded entirely from acquiring spectrum.

The case of Wireless DBS LLC is particularly telling because it implies that initial capitalization of any particular new entrant can be defeated by a "piling on" effect. Even an initial capitalization of $972,550,00. can be swamped when firms whose combined initial capitalization totals $2,256,230,000. systematically challenge every bid. It is hardly surprising that Wireless DBS LLC withdrew after the eleventh round.

Even more interesting is the fact that the major incumbents were apparently willing to pay a significant premium for engaging in the blocking bidding strategy: on average they paid 2.5 times more for the spectrum which they acquired than bidders who did not engage in this strategy. The difference in means between the dollars/MHz/pop price paid by major incumbents and all other bidders was statistically significant ($t = 4.812$, $p < 0.0001$).

This strategy adopted by major incumbents in the AWS-1 auction confirms Simon Wilkie's contention that

> [S]tandard FCC spectrum auctions, such as the recent AWS auction, strongly favor local geographic incumbent bidders and disfavor bidders with a national footprint business plan and actively discourage out-of-region competition. This likely means that new entrants, who will need such strategies in order to effectively compete with incumbent wireless providers, are disadvantaged by the auction design.[12]

IV. Exactly How the Major Incumbents Excluded Wireless DBS: A Case Study

Table 10 shows the strategic plan of Wireless DBS LLC for acquiring a national AWS footprint and exactly how it was blocked by major incumbents:

[12] Simon Wilkie, "Spectrum Auctions Are Not a Panacea: Theory and Evidence of Anti-Competitive and Rent-Seeking Behavior in FCC Rulemakings and Auction Design," WT Docket No. 07-16, April 26, 2007, 42.

Table 10.
Wireless DBS LLC's National AWS Footprint and How Incumbents Blocked It

License	Market Name	Round of First Bid	Round of Last Bid	No. of Bids	Challenging Incumbents (Round of Entry)	Ultimate Winner of License (Round PWB)
AW-REA001-F	Northeast	1	9	9	Cingular AWS LLC (1), MetroPCS AWS, LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1), Cricket Licensee (Reauction) Inc. (4), Cellco Partnership d/b/a Verizon Wireless (9)	Cellco Partnership d/b/a Verizon Wireless (16)
AW-REA002-F	Southeast	1	10	10	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS, LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1), Cricket Licensee (Reauction) Inc. (4)	Cellco Partnership d/b/a Verizon Wireless (14)
AW-REA003-F	Great Lakes	1	11	9	Barat Wireless LP (1), Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS, LLC (1), Cricket Licensee (Reauction) Inc. (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	Cellco Partnership d/b/a Verizon Wireless (14)
AW-REA004-F	Mississippi Valley	1	11	9	Barat Wireless LP (1), Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS, LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1), Cricket Licensee (Reauction) Inc. (4)	Cellco Partnership d/b/a Verizon Wireless (14)
AW-REA005-F	Central	1	11	10	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1), Cricket Licensee (Reauction) Inc. (3)	T-Mobile License LLC (15)
AW-REA006-F	West	1	9	8	Cellco Partnership d/b/a Verizon Wireless (1), Cingular AWS LLC (1), Cricket Licensee (Reauction) Inc. (1), MetroPCS AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	T-Mobile License LLC (15)

Table 10. (Continued)

Wireless DBS LLC's National AWS Footprint and How Incumbents Blocked It

License	Market Name	Round of First Bid	Round of Last Bid	No. of Bids	Challenging Incumbents (Round of Entry)	Ultimate Winner of License (Round PWB)
AW-REA007-F	Alaska	1	2	2	-	MTA Communications, Inc. (119)
AW-REA008-F	Hawaii	1	2	2	Cingular AWS LLC (1), SpectrumCo LLC (1), T-Mobile License LLC (1)	T-Mobile License LLC (108)
AW-REA001-D	Northeast	1	11	7	SpectrumCo LLC (1), Cingular AWS LLC (9), MetroPCS AWS, LLC (9), T-Mobile License LLC (10)	MetroPCS AWS, LLC (18)
AW-REA002-D	Southeast	1	7	5	Cricket Licensee (Reauction) Inc. (1), MetroPCS AWS, LLC (1), SpectrumCo LLC (1)	T-Mobile License LLC (15)
AW-REA003-D	Great Lakes	1	8	6	MetroPCS AWS, LLC (1), SpectrumCo LLC (1), Barat Wireless LP (4), Cricket Licensee (Reauction) Inc. (10)	Denali Spectrum License, LLC (20)
AW-REA004-D	Mississippi Valley	1	8	6	MetroPCS AWS, LLC (1), SpectrumCo LLC (1), Cingular AWS, LLC (4), Barat Wireless LP (8)	T-Mobile License LLC (15)
AW-REA005-D	Central	1	8	6	MetroPCS AWS, LLC (1), SpectrumCo LLC (1), Cingular AWS LLC (10)	Cingular AWS LLC (12)
AW-REA006-D	West	1	8	5	SpectrumCo LLC (1), MetroPCS AWS LLC (6), Cingular AWS, LLC (9)	MetroPCS AWS LLC (14)
AW-REA007-D	Alaska	1	2	2	-	Spotlight Media Corp (147)
AW-REA008-D	Hawaii	1	2	2	SpectrumCo LLC (1)	SpectrumCo LLC (97)
AW-REA001-E	Northeast	1	11	7	T-Mobile License LLC (1), Cingular AWS LLC (9), MetroPCS AWS LLC (9), SpectrumCo LLC (9)	T-Mobile License LLC (17)
AW-REA002-E	Southeast	1	10	6	Cricket Licensee (Reauction) Inc. (1), T-Mobile License LLC (1), Cingular AWS, LLC (9), SpectrumCo LLC (11)	T-Mobile License LLC (19)

Table 10. (Continued)

Wireless DBS LLC's National AWS Footprint and How Incumbents Blocked It

License	Market Name	Round of First Bid	Round of Last Bid	No. of Bids	Challenging Incumbents (Round of Entry)	Ultimate Winner of License (Round PWB)
AW-REA003-E	Great Lakes	1	10	6	T-Mobile License LLC (1), Cricket Licensee (Reauction) Inc. (3), MetroPCS AWS, LLC (6), Barat Wireless LP (8), SpectrumCo LLC (11)	T-Mobile License LLC (19)
AW-REA004-E	Mississippi Valley	1	10	5	T-Mobile License LLC (1), Barat Wireless LP (8), Cricket Licensee (Reauction) Inc. (10)	Barat Wireless, L.P. (16)
AW-REA007-E	Alaska	1	2	2	-	American Cellular Corporation (152)
AW-REA008-E	Hawaii	1	2	2	T-Mobile License LLC (1), Cingular AWS LLC (8)	T-Mobile License LLC (117)
AW-CMA001-A	New York-Newark, NY-NJ	1	11	5	T-Mobile License LLC (1), Cingular AWS LLC (11)	T-Mobile License LLC (23)
AW-CMA003-A	Chicago, IL	4	4	1	T-Mobile License LLC (1)	T-Mobile License LLC (51)
AW-CMA004-A	Philadelphia, PA	4	4	1	T-Mobile License LLC (1)	Cricket Licensee (Reauction), Inc. (48)
AW-CMA007-A	San Francisco-Oakland, CA	10	10	1	T-Mobile License LLC (1)	T-Mobile License LLC (26)
AW-CMA008-A	Washington, DC-MD-VA	4	4	1	T-Mobile License LLC (1)	Cricket Licensee (Reauction), Inc. (38)
AW-BEA010-B	NYC-Long Is. NY-NJ-CT-PA-MA-VT	5	10	2	Cingular AWS LLC (5), MetroPCS AWS LLC (10), SpectrumCo LLC (11)	SpectrumCo (20)
AW-BEA010-C	NYC-Long Is. NY-NJ-CT-PA-MA-VT	7	10	2	Cingular AWS LLC (3)	MetroPCS AWS, LLC (41)

Wireless DBS LLC’s strategy to obtain national AWS footprint initially concentrated on the REAG licenses, particularly the F block. However, immediately a threateningly consistent pattern of challenges from the major incumbents emerged from the first round: in two F blocks (AW-REA003-F – Great Lakes and AW-REA006-F -- West) it received six challenges in the first round, in another (AW-REA004-F – Mississippi Valley) five, in three others (AW-REA001-F -- Northeast, AW-REA002-F --

Southeast, and AW-REA005-F -- Central) four, and in another (AW-REA008-F -- Hawaii) three.[13] On four of these F block licenses additional pile-on challenges by other major incumbents took place in later rounds. These developments led to a decision to suspend bidding on two F block licenses in the ninth round (AW-REA001-F – Northeast and AW-REA006-F -- West) and one F block license in the tenth round (AW-REA002-F -- Southeast).

The strong challenges to acquisition of REAG F block licenses also occasioned two fundamental readjustments of Wireless DBS LLC's strategy, trying to accumulate necessary backup spectrum in the CMA blocks in the northeast, southeast, central, and western regions and BEA C and D block licenses in the northeast in the event that its REAG strategy were to fail. While Wireless DBS LLC bid on AW-CMA001-A (New York-Newark) from the first round, in the fourth round it bid on AW-CMA003-A (Chicago), AW-CMA004-A (Philadelphia), and AW-CMA008-A (Washington, DC-MD-VA), and was met by strong challenge from T-Mobile License LLC in each. In round ten, Wireless DBS attempted to break out of the stranglehold to its acquisition of an F block license in the west by bidding on AW-CMA007-A (San Francisco-Oakland); again it was met by T-Mobile. The attempts on AW-BEA010-B (NYC-Long Is. NY-NJ-CT-PA-MA-VT) in the fifth round and AW-BEA010-C (NYC-Long Is. NY-NJ-CT-PA-MA-VT) in the seventh round were equally abortive, resulting in withdrawal after the tenth round from both in the face of opposition from Cingular AWS LLC, MetroPCS AWS, LLC, SpectrumCo LLC and Cingular AWS LLC alone, respectively.

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[13] Alaska is anomalous in that Wireless DBS LLC made very little effort to acquire any of the REAG license blocks there. As in Hawaii, which is slightly less anomalous, Wireless DBS LLC made no bids on any Alaskan license after the second round. This probably reflects a decision to suspend bidding until the situation of licenses in the lower forty-eight states was resolved.

In the REAG D and E blocks different, but equally threatening patterns quickly emerged:

• Confrontation by one or more major incumbents in the first round, followed by pile-on of several additional major incumbents from the fourth to eleventh rounds (AW-REA001-D, AW-REA003-D, AW-REA004-D, AW-REA005-D, AW-REA006-D, AW-REA001-E, AW-REA002-E, AW-REA003-E, AW-REA004-E, AW-REA005-E, and AW-REA006-E, and AW-REA008-E). At no point in bidding on these licenses did Wireless DBS LLC face less than three incumbents, except Hawaii, where it faced two.

• On AW-REA001-D (Northeast) and AW-REA002-D (Southeast) Wireless DBS LLC faced the REAG F block pattern: multiple initial challenges from major incumbents.

By the seventh to tenth rounds it was apparent that Wireless DBS LLC was effectively blocked from acquiring the REAG D and E block licenses necessary for a national footprint. By the eleventh round this was equally apparent for the REAG F block licenses. Wireless DBS LLC perforce withdrew from the auction after the eleventh round.

There are a set of tantalizing patterns of incumbent behavior in the REAG D and E blocks which suggests that more than tacit collusion may have been involved. SpectrumCo bid entered in the first round against Wireless DBS 56.33% of the time when it entered. T-Mobile License entered in the first round 75.00% of the time when it entered. MetroPCS AWS LLC entered in the sixth or ninth rounds 66.67% of the time when it entered. Barat Wireless LP entered in the eighth round 75.00% of the time when it entered. Cingular AWS LLC entered in the ninth or tenth round 75.00% of the time when it entered. These patterns are not maintained in the bidding of these incumbents on licenses on which Wireless DBS LLC did not bid and it is difficult to see a strategic reason for this pattern to hold in the REAG D, E, and F blocks on which Wireless DBS LLC bid except as a blocking hierarchy: SpectrumCo LLC and T-Mobile were the early round blockers, MetroPCS AWS LLC and Barat Wireless LP were the mid-to-late round reinforcements, and Cingular AWS LLC was the late round reinforcement. It is difficult to see how this pattern emerged by chance.

The incumbents were remarkably blithe about which incumbent ultimately acquired the licenses. Verizon, which was the least significant blocker of targeted new entrants, did quite well. The ultimate allocation generally continued the pattern of incumbents securing spectrum in geographic regions in which they were already hegemonic and avoiding competition within those regional hegemonies. Furthermore, a strong pattern emerged in which the majority of incumbents ceased to pursue the licenses they were challenging once it became apparent that Wireless DBS LLC had dropped out. Table 11 displays these findings for the vital REAG F Block:

Table 11.
Patterns of Bidding by Incumbents Prior to and Post Wireless DBS LLC Withdrawal from Bidding on REAG F Block Spectrum

		AW-REA001-F	AW-REA002-F	AW-REA003-F	AW-REA004-F	AW-REA005-F	AW-REA006-F	Percent of Licenses Bid On
Round of PWB		16	14	14	14	15	15	-
Barat Wireless LP	**Prior**	0	0	6	7	0	0	33%
	Post	0	0	0	0	0	0	0%
Cellco Partnership d/b/a Verizon Wireless	**Prior**	1	6	8	6	10	8	100%
	Post	4	3	3	2	2	2	100%

Table 11. (Continued)
Patterns of Bidding by Incumbents Prior to and Post Wireless DBS LLC Withdrawal from Bidding on REAG F Block Spectrum

		AW-REA001-F	AW-REA002-F	AW-REA003-F	AW-REA004-F	AW-REA005-F	AW-REA006-F	Percent of Licenses Bid On
Cingular AWS LLC	**Prior**	7	6	9	2	8	7	100%
	Post	0	0	2	0	0	0	17%
Cricket Licensee (Reauction) Inc.	**Prior**	7	7	7	4	6	6	100%
	Post	0	1	3	0	1	0	50%
Denali Spectrum License LLC	**Prior**	5	1	0	0	0	2	50%
	Post	0	0	0	0	0	0	0%
MetroPCS AWS LLC	**Prior**	7	0	0	0	0	5	33%
	Post	0	0	0	0	0	0	0%
SpectrumCo LLC	**Prior**	9	9	9	7	7	8	100%
	Post	0	0	1	0	0	0	17%
T- Mobile License LLC	**Prior**	7	8	7	7	7	6	100%
	Post	3	3	3	2	3	3	100%

Only Verizon and T-Mobile routinely persevered to the end for the REAG F Block. The remainder routinely ceased bidding on these crucial licenses immediately after Wireless DBS LLC had withdrawn. This suggests that the bidding prior to Wireless DBS' withdrawal was less "competition" for these licenses than strategic blocking to prevent Wireless DBS LLC from acquiring them.

V. Conclusions.

Careful examination of the evidence from the AWS-1 auction leads to a number of salient conclusions:

- There was a concerted effort by major incumbents to target those new entrants which harbingered significant potential competitive broadband threat if (1) they acquired national AWS footprint in the AWS-1 auction or (2) they acquired a strong regional or multi-regional base from which they could acquire national footprint in future auctions.

• Such targeted new entrants were met with a strategy of blocking bidding, i.e., coalitions of multiple major incumbents which bid for the purpose of denying licenses to the new entrant rather than acquiring the licenses for themselves. A majority of the major incumbents ceased bidding on such licenses after the targeted new entrant ceased bidding.

• The strategy of blocking bidding was extremely successful. Of the four targeted new entrants against whom blocking bidding was deployed only one managed to obtain any spectrum in the auction. A less competitive market resulted from the AWS-1 auction.

• Major incumbents found the strategy of blocking bidding to deny targeted new entrants sufficiently useful to be willing to pay a significant premium for it: they paid on average 2.5 times more for the spectrum they obtained than bidders who did not use this strategy.

• Blocking bidding was possible only because incumbents were able to identify the licenses which targeted new entrants sought in the auction. If anonymous bidding had been used, this strategy would not have been available.

• The incumbents were wrong; their opponents were right.

VI. Recommendations for Future Auctions.

Blocking bidding depends entirely on the ability of incumbents to identify those licenses on which new entrants are bidding: the only way in which blocking bidding strategies can be prevented is adoption of strict anonymous bidding rules. If it is the FCC's intention that the allocation of licenses should result in markets which are genuinely competitive and from which new entrants are not excluded because they cannot acquire adequate footprint, then it has little other alternative. Package biding schemes and increasing the size of licenses cannot diminish blocking bidding as the evidence of the AWS REAG F Block demonstrates, since even relatively large license sizes exhibited blocking bidding. The fundamental problem is incumbents knowing whom to target, and this remains a problem for the 700 MHz and other future auctions in the absence of anonymous bidding.