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November 10, 1993

William F. Caton
Acting Secretary
Federal Communications Commission
Mail Stop 1170
1919 M Street, N.W., Room 222
Washington, D.C. 20554

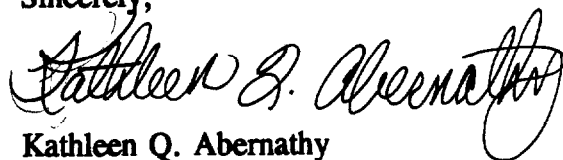
Dear Mr. Caton:

Re: *PP Docket No. 93-253*

On behalf of PacTel Corporation, please find enclosed an original and six copies of its "Comments" in the above proceeding.

Please stamp and return the provided copy to confirm your receipt. Please contact me should you have any questions or require additional information concerning this matter.

Sincerely,


Kathleen Q. Abernathy

Enclosures

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of:
Implementation of Section 309(j)
of the Communications Act
Competitive Bidding

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PP Docket No. 93-253

COMMENTS OF PACTEL CORPORATION

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November 10, 1993

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Summary

PacTel recommends that the Commission adopt an auction scheme for wideband PCS that provides for several rounds of sealed bids in which all geographic areas for a given spectrum block are auctioned simultaneously. This approach best meets the Commission's goals of rapid deployment of services, licenses awarded to the parties who value them the most, promotion of efficient use of the spectrum, simplicity in administration and facilitation of the efficient aggregation of licenses.

Repeated rounds of sealed bids for the broadband PCS auctions maximizes the release of information to bidders, thus ensuring more accurate license valuation. In addition, it promotes more efficient aggregation of geographic areas and ensures that bidders can consult with management and consortium partners throughout the bidding process. It is superior to the oral auction proposal outlined by the Commission because it permits concealment of identities of bidders, thereby encouraging aggressive bidding, while also allowing auctions to be completed more rapidly.

PacTel also urges the Commission to reject the proposed combinatorial bidding scheme. The proposal only makes sense if a national license is likely to be the only important geographic aggregation of licenses in the auction. At this time, however, no one knows the most efficient and effective aggregation of licenses. Therefore, it best serves the public interest for the Commission to adopt PacTel's sealed bid proposal because it allows the marketplace to determine the most efficient combination of licenses, be that nationwide or regional.

With regard to application processing requirements, PacTel recommends that the Commission not require long-form applications from any bidders prior to the identification of

a winning bidder. Such information is unnecessary and unduly burdensome. The Commission is better served by simply requiring each applicant to submit such information and assurances as are necessary to demonstrate that the applications are acceptable for filing.

PacTel does not support adoption of competitive bidding procedures for intermediate links used by common carrier licensees. First, the microwave spectrum used to provide these links is not a "for compensation" service. Second, today the point-to-point microwave radio licenses used as intermediate links are frequency coordinated before any application is filed. Adoption of bidding procedures for these licenses will undermine the very successful frequency coordination process already in place.

Lastly, PacTel notes that application of bidding procedures to certain of the cellular "unserved areas" and to automatic vehicle monitoring (AVM) systems would be inappropriate. With regard to unserved areas, the Commission can not lawfully implement auctions for the pending 1988 cellular license modification applications filed by PacTel's affiliate, Los Angeles SMSA Limited Partnership ("LASLP"). LASLP's applications involve modification of an existing cellular license and therefore do not qualify as new construction permits and licenses. Further, the existing litigation surrounding LASLP's license modification applications, and the fact that the applications have been pending for more than five years, militates against the use of auctions. With regard to AVM services, the service is assigned to a band that is primarily allocated to ISM and government. Therefore, AVM users always operate on a secondary basis in spectrum where the principal use is not for the provision of service to subscribers for compensation.

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C.

In the Matter of:)
Implementation of Section 309(j)) PP Docket No. 93-253
of the Communications Act)
Competitive Bidding)

Comments of PacTel Corporation

Introduction

PacTel Corporation, a subsidiary of Pacific Telesis Group, is filing these comments in response to the Commission's Notice of Proposed Rulemaking in the above captioned proceeding. PacTel Corporation is the holding company for PacTel wireless subsidiaries providing cellular, paging, and vehicle location services in U.S. and overseas markets¹.

PacTel's comments focus primarily on the Commission's proposed auction design for broadband PCS, consisting of oral auctions for individual licenses and a separate sealed-bid auction for a combination of geographical areas. PacTel recommends an alternative auction design which we believe will better serve public interest goals. The preferred approach is to use several rounds of sealed bids in which all geographic areas for a given spectrum block are

¹Pacific Telesis Group Board of Directors approved a plan in December, 1992 to spinoff PacTel wireless operations as an entirely independent business from its local telephone companies, Pacific Bell and Nevada Bell. Pacific Telesis Group expects to complete the spinoff in the first half of 1994.

auctioned simultaneously. Such an approach maximizes the information released to bidders, which assists bidders in more accurately estimating license values, and tends to ensure that bidders who most highly value licenses win.

PacTel's recommended approach of simultaneous rounds of sealed bids permits more efficient aggregation of geographic areas. Bidders are able to make interdependent bids, and to bid aggressively on the aggregation of their choice, allowing the market to decide which aggregations should arise. Oral auctions, necessarily sequential because a bidder cannot be in two places at once, raise the problem of correctly ordering the sales. Oral auctions will bias the outcome towards market aggregations centered around the properties auctioned first.

The use of simultaneous rounds of sealed bids overcomes two other defects in the use of oral auctions. First, oral auctions reveal the identity of the bidders which leads to less vigorous competition and lower prices than would occur with several rounds of anonymous sealed bids. Second, oral auctions prevent parties from using information about license values released during bidding, because there is no opportunity to consult with management or consortium partners and to adjust bidding strategy accordingly.

Finally, PacTel opposes the Commission's proposed combinatorial bidding scheme because it can result in lower prices on individual licenses and less efficient combinations of licenses than PacTel's preferred approach.

I. Application of Competitive Bidding Procedures to Wideband Personal Communications Services.

The Commission's task in developing an auction process for PCS licensing is a daunting one, with thousands of licenses to be awarded under short deadlines, billions of dollars in potential revenues, and numerous legislative requirements. The objectives outlined in the Notice are diverse: rapid deployment, licenses awarded to the parties which value them most, promotion of efficient use of the spectrum, simplicity in administration, and facilitation of the efficient aggregation of licenses. Given the complexity and lack of precedent for an auction of the magnitude of PCS, PacTel has enlisted the participation of an experienced auction theorist to assist in the evaluation of the various auction designs available to the Commission.

As an Exhibit to this filing, PacTel has attached a report prepared by a noted auction expert, Dr. Preston McAfee of the University of Texas at Austin². Based upon his years of experience in the study of auction design and use, Dr. McAfee has developed a recommendation for the auctioning of PCS licenses which he believes best serves the Commission's objectives for licensing this industry. PacTel concurs in his recommendations.

²PacTel's auction design recommendations apply only to auctions for broadband PCS licenses which raise different issues than those raised for narrowband PCS licenses. Issues related to competitive bidding for narrowband PCS will be addressed in a separate filing by PacTel Paging in conjunction with other parties with narrowband interests.

Consistent with Dr. McAfee's recommendations, PacTel proposes the use of several rounds of sealed bids in which all geographic areas for a given spectrum block are auctioned simultaneously. The mechanics of this approach are described in detail in his attached paper, as are the advantages of this approach over oral sequential or single round sealed bids. Specifically, these advantages include simplicity in operation, greater release of information to the bidders, ability of bidders to consult with management and partners, anonymity of bidders (which increases bid competition and discourages collusion), more rapid completion of licensing, more efficient aggregation of licenses, increased availability of data to the Commission for evaluation, and greater government revenue. Dr. McAfee also counsels against combinatorial bids, such as the separate auction for a national license proposed by the Commission, because this approach has a dampening effect on individual license bids and leads to less efficient aggregation of geographical areas.

A further issue addressed in Dr. McAfee's paper is the treatment of designated entities.³ Based upon studies of other government auctions in which specific entities were favored for public policy reasons, Dr. McAfee concludes that price preferences rather than set asides better achieve government goals for inclusion of designated groups.

³See Section III.C. of the Notice.

With regard to the alternative payment plans set forth in Paragraphs 68-71 of the Notice, Dr. McAfee specifically recommends against royalty payments for PCS auctions. Such payments create disincentives to fully develop the license, lead to inefficient pricing of services, and are extremely complex to administer and police.

II. Application Processing Requirements

In Paragraph 97, the Commission proposes that applicants be required to submit both a short-form application and a long-form application prior to an auction for any given license. Given the significant uncertainties about the value of broadband PCS licenses, the massive number of licenses being awarded, and the embryonic state of PCS technology, the Commission should not require long-form applications from any bidders other than after a bidder has won a particular license. Requiring long-form applications prior to PCS auctions would be unreasonably burdensome on the industry, provide unnecessary information to the Commission, and is not required by the statute.

Section 309(j)(5) requires bidders to file such information and assurances as the Commission may require to demonstrate that their applications are acceptable for filing. As the House Report clarifies, the Commission has the discretion to make the determination of bidder

qualifications and compliance with application rules after the competitive bidding procedure⁴.

PacTel strongly urges the Commission to keep to a minimum the up front information required and not require bidders to submit long form applications, such as FCC Form 401, until and unless a bidder has been identified as the winning applicant. Prior to the auction, the Commission need only know the identity of the applicant, including all parties in interest, their legal qualifications as to citizenship and character, and their financial ability to participate in the auction process. Such a short-form filing would adequately fulfill the statutory requirement that mutually exclusive applications be identified as a condition precedent to conducting a license auction⁵.

A critical reason to avoid requiring license-specific technical data is related to PacTel's recommended auction design for broadband. Bidders will not always know ahead of time in which auctions he or she will actively participate, particularly given the uncertainties surrounding the value of PCS licenses. For example, a small business interested in providing service somewhere within a MTA may simply want to bid on the BTA which appears to be available at the lowest price. Alternatively, a large company may want to provide service in as many MTAs as it can afford to bid on, depending upon the levels at which the bidding closes.

⁴H.R. Rep. No. 103-111 at 258.

⁵Section 309(j) (1).

Thus, in the case of simultaneous auctions, bidders would be required to file license-specific applications for hundreds of markets which they are unlikely to pursue, but for which they may want to keep their options open as the bidding progresses. Such a result could deter serious applicants from participation and lower the prices obtained for PCS licenses. As long as the Commission can evaluate the basic legal and financial qualifications of the bidder, any needed technical showings can be made in a supplemental filing following the acceptance of a winning bid. The short-form application could be put on public notice after the auction, and if the winning bidder is deemed ineligible to hold the license, the second highest bidder should be declared the winner.

Even after a winning PCS bidder has been identified, the Commission should require only the very minimum of technical information needed to meet the statutory requirements of Section 308(b). PCS is unique among licensed services for several reasons. Detailed engineering plans in advance of actual transmitter application and authorization are required for other services so that the Commission can be assured that a licensee intends to utilize fully the spectrum awarded. By investing millions of dollars in the right to hold a PCS license, PCS licensees will have more of an economic incentive to get their systems built and operational than licensees who can obtain spectrum for free. Furthermore, the extremely harsh forfeiture-of-license

penalty imposed upon PCS licensees who fail to meet the build-out requirements further undercuts the possibility that a licensee will fail to develop a system.

Finally, advance engineering plans containing transmitter sites, power levels, and other technical data are likely to change dramatically over the life of the license as PCS technology, now in its earliest stages, matures. All PCS licensees will be required to experiment as they go, working through the standards process, dependent upon equipment which has yet to be manufactured. Negotiations over relocation of existing microwave users within a spectrum band will also effect network design and development. Rather than burden parties with paperwork requirements unlikely to reflect actual system configurations, the Commission should make a determination that the public interest is best served by a requirement that PCS licensees need only file transmitter-specific engineering forms.

III. Application of Competitive Bidding to Intermediate Links in Proposed or Existing Common Carrier Services

In Paragraphs 29 and 157 in the Notice, the Commission proposes that point-to-point microwave radio licenses used as an intermediate link in the provision of continuous, end-to-end service should be subject to competitive bidding. PacTel strongly opposes this conclusion as contrary to the statutory criteria and the public interest.

First, under today's rules, microwave licenses are frequency coordinated before the application is filed. Such a process has served the industry well; links are efficiently allocated to parties on a first-come, first-served basis, with minimum use of Commission resources. For parties wishing to protest approval of specific applications based upon disagreements with the decision of frequency coordinators, hearings may be conducted by the Commission.⁶

Adoption of competitive bidding procedures for these services would likely increase the number of mutually exclusive applications filed, contrary to the provisions of Section 309(j)(6)(E). This Section states:

(6) Nothing in the subsection, or in the use of competitive bidding shall . . .(E) be construed to relieve the Commission of the obligation in the public interest to continue to use engineering solutions, negotiations, threshold qualifications, service regulations, and other means in order to avoid mutual exclusivity in application and licensing proceedings.

PacTel believes that adoption of competitive bidding for point-to-point microwave frequencies will undermine the frequency coordination process, and increase the risk of "greenmailers" interested in pay-offs from licensees anxious to avoid the costs and delays of mutually exclusive licensing situations.

Second, the licensee of microwave spectrum used to interconnect cells in a cellular or future PCS system is not offering microwave service for compensation as required by

⁶See 47 CFR Section 21.32(e).

Section 309(j)(2)(A). The internal operations of a network such as a backhaul link to aggregate and route traffic efficiently may include a variety of options including constructing a private microwave system, leasing microwave links from a common carrier provider, installing fiber lines, or leasing local exchange facilities. Mobile subscribers are not transmitting directly or receiving calls on any of these facilities.

Finally, common carrier uses for microwave links are comparable to other private network applications such as microwave systems employed by electric utilities, railroads, and oil companies. Equity requires that one group of microwave users not be singled for payment when other parties, similarly using microwave for internal purposes, would be exempt from competitive bidding because they are in a different industry.

IV. Application of Competitive Bidding to Cellular License Modification Applications

In its Notice, the Commission proposed to employ the competitive bidding process for cellular "unserved area" license applications filed prior to July 26, 1993.⁷ In deciding whether to adopt this proposal, it is important for the Commission to recognize that it does not have the lawful authority to use auctions regarding the pending 1988 cellular license modification applications filed by PacTel's

⁷Notice at Paragraph 160.

affiliate, Los Angeles SMSA Limited Partnership ("LASLP") regarding certain "unserved areas" of the Greater Los Angeles market.

It would be unlawful for the Commission to attempt to use auctions with regard to LASLP's 1988 license modification applications for two reasons. First, as the Commission itself has recognized, its authority to use auctions extends only to the issuance of new construction permits and licenses and not to license modification applications.⁸ Because LASLP's 1988 applications seek authority to modify its existing cellular license for Los Angeles, the Commission cannot lawfully use an auction for these applications.

Second, the use of auctions would violate the spirit, if not the letter, of the U.S. Court of Appeals for the District of Columbia Circuit's decision to reinstate nunc pro tunc LASLP's 1988 license modification applications.⁹ Similarly, a decision to use auctions with the applications that were reinstated nunc pro tunc by the U.S. Court of Appeals by the McElroy decision would be inconsistent with the Commission's statutory mandate that it use auctions for only those license applications filed prior to July 26, 1993 where it would be in the public interest. Since there are only three applicants with timely filed "unserved area" applications for the Greater Los Angeles market and they

⁸Notice at Paragraph 2; See also revised Section 309(j) of the Communications Act.

⁹See McElroy Electronics Corp. v. FCC, 990 F 2d 1351 (D.C. Cir. 1993).

have been pending for more than five years, use of auctions with those applications would certainly not be in the public interest.

V. Application of Competitive Bidding to Automatic Vehicle Location Systems

In footnote 153 of the Notice, the Commission proposes to delay action on the applicability of competitive bidding to Automatic Vehicle Monitoring services, pending resolution of certain fundamental questions about the nature of this service now being considered in a separate proceeding.¹⁰ The Notice tentatively concludes, however, that because AVM frequencies are shared with the government, which is primary in this band, the principal use of these frequencies might not be for the provision of service to subscribers for compensation, as contemplated by Section 309(j).

Competitive bidding would not be appropriate for the 902-928 MHz band. The principal reason is that AVM would not have exclusive use of the band, even assuming AVM is awarded some type of protection from interference for its signals (co-channel separation). The primary users in the band are ISM and government. AVM, amateur radio and Part 15 (unlicensed) devices operate in the band only on a secondary basis. In a co-channel environment, this hierarchy of use would not change, and AVM would continue to be secondary to ISM and Government.


¹⁰Notice of Proposed Rulemaking, PR Docket No. 93-35, 8 FCC Rcd 2227 (1993).

Conclusion

PacTel urges the Commission to adopt PacTel's auction design proposal for PCS as one that better meets the Commission's goals simplicity, efficiency, and rapid deployment than either oral auctions or combinatorial bidding. License processing requirements should be minimized to reflect the unique characteristics of PCS.

Additionally, competitive bidding authority should not apply to intermediate links, cellular license modifications, or Automatic Vehicle Monitoring services, for the reasons stated above.

Respectfully Submitted,


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November 10, 1993

Auction Design for Personal Communications Services

by

R. Preston McAfee

Rex G. Baker, Jr., Professor of Political Economy

University of Texas at Austin

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Executive Summary

In its Notice of Proposed Rule Making, the Federal Communications Commission tentatively recommends that spectrum license rights for Personal Communication Services be sold in a two-part auction with both oral auctions for specific geographic areas and a separate sealed-bid auction for a national license. This proposed auction design has several important flaws that can be corrected to ensure that the license rights are sold in an efficient manner that also raises substantial revenues.

The best practical manner in which to auction the PCS licenses is to use several rounds of sealed bids in which all geographic areas for a given spectrum block are auctioned simultaneously. Using several rounds of sealed bids eliminates three serious defects of the oral auctions proposed by the Commission.

First, oral auctions are necessarily sequential, which makes efficient aggregation of different geographic areas difficult. In particular, oral auctions raise the problem of correctly ordering the sales. This requires the Commission to forecast the efficient aggregations, which seems impossible to know in advance. It is preferable to let the market choose the aggregations that make good business sense. Such market choice requires simultaneous bidding.

Second, oral auctions permit bidders to observe the identities of their competitors, raising the likelihood of collusion by rivals. While explicit collusion is unlikely given the nature of the bidding firms, exposing the identities of bidders will likely lead to less intense competition and lower prices than would occur with several rounds of anonymous, sealed-bids.

Third, oral auctions reduce the ability of bidders to consult with management or consortium partners and eliminate the opportunity for careful deliberation in bidding. Thus the speed at which an oral auction operates eliminates the major advantage of oral

auctions over one-time, sealed-bids: the incorporation of information regarding other firms' bids into the bidding process.

Furthermore, the use of a separate national license to facilitate aggregation is both unnecessary and inefficient. With simultaneous ascending bid auctions, a national geographic area can be readily assembled by a bidder. Moreover, auctioning a national license separately will likely to lead to inefficient aggregation. The existence of a separate auction for a national license also reduces competition for the individual licenses, leading to lower prices.

The extra release of information, along with careful deliberation by the bidders in forming their bids, allowed by several rounds of sealed bids will lead to (1) more efficient aggregations of licenses; (2) higher average prices for the licenses; and (3) more informed decisions by the bidders. In sum, the recommended auction design, with several rounds of sealed bids for the simultaneous sale of different geographic areas, is preferable to the Commission's two-part auction design.

I. Introduction

A. Purpose of Statement

My name is R. Preston McAfee. I am *Rex G. Baker, Jr.*, Professor of Political Economy at the University of Texas at Austin.¹ Based on my expertise in the field of auctions,² PacTel Corporation ("PacTel") retained me to develop a recommended auction design for Personal Communication Services ("PCS") spectrum auctions as described in the Federal Communication Commission's Notice of Proposed Rule Making ("Notice") dated October 12, 1993. This report contains my recommendations for consideration in this rule making.

B. Goals of Auction Design

In preparing this report, I consider three primary goals: simplicity, efficiency, and revenue. First, the auctions should be simple to operate and easily understood by the bidders, to minimize the transactions costs and confusion associated with their implementation (see Notice at ¶ 18). For this reason, I restrict attention to standard auction forms (sealed-bid and oral ascending auctions) that are commonly used to sell a large variety of items.³

¹ Formerly, I was Professor of Economics at the University of Western Ontario. I hold M.S. and Ph.D. degrees from Purdue University, and a B.A. degree from the University of Florida. I am a Co-Editor of the *American Economic Review* and an associate editor of the *Journal of Economic Theory*.

² I have spent much of my professional career studying the design and use of auctions. I have published twenty articles and a book concerning various aspects of auctions. Many of these articles have appeared in the leading professional journals, including the *American Economic Review*, *Econometrica*, and the *Journal of Economic Theory*. My book, *Incentives in Government Procurement* (with John McMillan, published by the University of Toronto Press, 1988), is an analysis of the design of procurement auctions.

The restriction to simple auctions narrows the focus of consideration to variants of two basic and popular auction forms. These include the *first-price, sealed-bid* auction, in which bidders independently submit bids with the highest bidder winning and paying the highest bid, and *ascending bid* auctions, in which prices are successively raised to the point where only one bidder is willing to pay the prevailing price, i.e., where the second-highest bidder drops out. Such ascending bid auctions are usually carried out in an *oral* fashion, for example by the famous auction houses *Christie's* and *Southeby's*. Oral ascending bid auctions are commonly known as *English* auctions.

Second, within the range of simple auctions, I consider the efficiency of the spectrum allocation that should result from the auction. In particular, the auction should be designed to allocate the license to the highest value bidder (see Notice at ¶ 34 and footnote 26) and to produce efficient geographic aggregations of licenses. Such aggregations would promote single ownership of neighboring geographic areas whenever this enhances the value of the licenses and permits consumers to be offered a superior, more valuable product (see Notice at ¶ 35). In particular, it is important to attempt to design the auction so that the efficient aggregations arise immediately, and the use of an after-market in licenses is minimized (see Notice at footnote 21).

Third, I consider that the revenue raised by the government should capture most of the value of the licenses so that applicants not obtain unjust enrichment. I give efficiency priority over revenue in making my assessments, following the Commission's stated goals (see Notice at ¶ 14).

The remainder of the report is organized as follows. Section II outlines the recommended auction design and discusses its advantages compared to the Commission's proposed auction design. Section III discusses the details of the recommended auction

³ I do not recommend the Dutch Auction for the reasons given in the Notice at ¶ 42. In addition, the advantages of the second price sealed-bid or Vickrey auction are primarily theoretical in nature.

design. Section IV examines policies toward designated entities. Section V considers the use of experimentation to refine the auction design so as to further the Commission's objectives and discusses how to evaluate the success of the auctions. The summary and conclusions are contained in section VI. A copy of my curriculum vitae is provided in Appendix A. Sample forms on which bidders could record their bids and on which the Commission could record those bids are contained in Appendix B. Finally, Appendix C discusses several technical matters: simultaneous auctions of Channel Blocks A and B, reserve prices, royalty payments, and risk aversion.

II. Recommended Auction Design and Its Advantages

A. Summary of the Recommended Auction Design

My recommendation is that the Commission employ multiple rounds of sealed-bid auctions,⁴ simultaneously auctioning every geographic region⁵ for a given block of the spectrum, but sequentially auctioning the seven spectrum blocks. Effectively, multiple rounds of sealed-bids represent a written version of the *English* auction. After a given round, the maximum bid obtained in that round is announced to the bidders, and the maximum becomes the minimum valid bid for the next round (a minimum increment should be imposed to ensure a speedy termination of the auction). The details of the recommended auction design are provided in section III.

⁴ This auction form is mentioned in the Notice at footnote 26.

⁵ Given the large number of BTAs to be auctioned, it may be desirable to divide the nation into several broad regions, auctioning every BTA in a broad region simultaneously, then auctioning the BTAs of a second region, and so forth.

B. The Importance of Information Release in Auctions

A central issue in auction design is the release of information during the course of the auction to the bidders. This subsection explains how the release of information affects bidding behavior, and why ascending bid auctions tend to produce more efficient outcomes and higher average prices than first-price, sealed-bid auctions.⁶ Bidding behavior in auctions is determined by the information held by the bidders. Typically bidders know something, but not everything, about the value of the item for sale.⁷

For example, potential bidders for PCS licenses are uncertain about consumer demand, future technological developments, the nature of future competition, the costs of implementing PCS, and the resale value of PCS licenses. All of these factors influence the profitability and hence the value of PCS licenses. Given these uncertainties, the auction should be designed to provide bidders with as much information as possible, which means providing information about other bidders' estimates of the licenses' values in the process of running the auction.

By their nature, auctions tend to allocate the licenses to the most optimistic bidders, a phenomenon known as the *winner's curse*. Selling by auction ensures that the licenses will typically be allocated in an efficient manner, because the bidder who can put the license to the highest value use is willing to pay more, and hence will tend to win the auction. However, each bidder will take into account that, if it wins the auction, all the other bidders had lower estimates of the value of the license. Typically, knowing that other bidders assigned a lower value to the license means that each bidder would like to

⁶ See Milgrom and Weber (1982), "A General Theory of Auctions and Competitive Bidding," *Econometrica*.

⁷ An applicant's "valuation" of a license equals the maximum that it would pay for that license. Applicants will generally bid less than their valuations.

revise downward their estimate of the value, to adjust for the fact that it was the most optimistic bidder.

First-price, sealed-bid auctions, which permit no revision of bids, require a bidder to adjust for the winner's curse in preparing its bid. In contrast, in ascending bid auctions, a bidder can base its bids on the bidding behavior of others. Seeing other bidders bid aggressively, for example, causes each bidder to revise its estimates upward, because the bidders observe that others also have high estimates of the value of the item for sale. Upon observing faltering and weak bidding, each bidder revises downward its estimate of the value. Essentially, ascending bid auctions insure a bidder against major mistakes in estimating the value, since a major error will become apparent. Major underestimates of the value are revealed by aggressive competition, and major overestimates of the value are revealed by other bidders dropping out unexpectedly early in the bidding. In summary, *ascending bid auctions release more information about the value of the license than sealed-bid auctions.*

The information released in ascending bid auctions increases the revenue accruing to the seller relative to one-time, sealed bid auctions. Eventually an ascending bid auction becomes a competition between two bidders, the one with the highest value of the license and the one with the second highest value. As the bids increase, bidders are observed to drop out or cease bidding. The effect of this is to provide information to the remaining bidders, information about the bidders with lower estimates of the value. By providing this information, ascending bid auctions tend to make the two highest bidders' information similar, and hence their valuations of the license closer. This brings the second highest bidder's estimate closer to the actual expected value of the license, and hence the price paid becomes closer to the actual value. *Ascending bid auctions produce higher prices than first-price, sealed-bid auctions.*

Therefore, insuring the bidders against massive overestimates of the value of the license by releasing information makes them more aggressive in the bidding, and in

particular makes the second highest bidder more aggressive, which drives the price closer to the actual value of the license. For this reason, it is in the seller's interest to release all available information about the value of licenses to the bidders. Thus, the Commission should release all available information regarding the value of the licenses because this tends to make the information held by bidders more similar, which raises average sales prices thereby inducing a more efficient allocation of licenses.

C. Advantages of the Recommended Auction Over Use of Oral Auctions

Multiple rounds of sealed-bids capture a number of advantages over the Commission's proposed use of oral auctions. These advantages are as follows.

1. More information released by the auction to bidders

The primary difference in the release of information between simultaneous sealed-bid auctions and the Commission's proposed sequence of oral auctions is that in the former, bidders can gather information regarding how other bidders value all the licenses, while in the latter, bidders can only gather information on the current license and licenses sold in prior oral auctions. This ability to pool information regarding the values of many PCS licenses simultaneously will assist bidders in more accurately estimating the values of the licenses for which they bid. Thus, simultaneous, sealed-bid auctions with several rounds of bidding will be efficient because they will award licenses to the applicants who value them most highly.

2. Bidders can consult with management and consortium partners

As a practical matter, firms are not likely to give a single individual or even a team of bidders much discretion in making bids that may be in the range of tens to hundreds of millions of dollars. Therefore, bidders are likely to be told by management to bid up to a given level and no higher. The effect of this is to prevent the companies from using information released by the auction. Effectively, an oral auction becomes equivalent to a second-price auction,⁸ because each bidder will have a dollar value that they may bid, and the price obtained will be the second highest such value. This inability to revise the bids based on information release prevents oral auctions for PCS licenses from permitting the revision of bids which constitutes the primary advantage of an ascending bid auction.

3. Permits concealment of identities of bidders

Unlike oral auctions, multiple rounds of sealed-bids permit the Commission to keep the identities of the bidders secret, thereby making collusive agreements more difficult to enforce and generally discouraging collusion. However, explicit collusive agreements, where bidders meet prior to an auction to agree to restrain competition, rarely involve large corporations. Explicit collusion carries mandatory prison sentences under the 1987 Federal Sentencing Guidelines. It is difficult to motivate managers to risk prison in order to obtain the benefits of explicit collusion, since these benefits primarily accrue to the shareholders of the corporation. Indeed, explicit collusion is generally found only among

⁸ A second-price sealed-bid auction is an auction wherein each bidder submits a bid, and the high bidder pays the second highest bid.

small firms that are owner-operated, so that those bearing the risk of imprisonment capture the benefits of the risky collusive behavior.⁹

Implicit collusion, where bidders do not discuss the sharing of the market, but nevertheless do not compete fully, is probably much more common. Implicit collusion involves a mutual understanding that if none of the firms compete vigorously, all will earn higher profits. Both explicit and implicit collusion rely on bidders knowing their competitors. Either type of collusive behavior will tend to break down if competition comes from outside firms, shrinking the size of the market available to the collusive group. Since the oral auctions proposed by the Commission would enable the bidders to know their competitors, implicit collusion and the resulting lower prices are more likely to occur than with repeated rounds of sealed bids.

4. Auctions can be run simultaneously

Oral auctions, which require a bidder to be present, are necessarily sequential. This means the Commission must cleverly choose the order in which the auctions are operated in order to obtain an efficient outcome. Since it is not at all clear which order is best, this creates a difficult problem for the Commission and increases the likelihood of deterring efficient aggregations of licenses. In contrast, running the auctions simultaneously permits the bidding to determine the ordering of closing of the auctions, thereby facilitating optimal license aggregations.

It is not obvious that ordering the licenses from the most populous MTA to the least populous MTA, as suggested by the Commission, is optimal. With such an ordering, the most valuable licenses are auctioned first. This means that information from less

⁹ See McAfee and McMillian (1992), "Bidding Rings," *American Economic Review*.

valuable licenses, relevant to bidding on the more valuable licenses, will not be available when the more valuable licenses are auctioned.

In contrast, multiple rounds of sealed-bids permit bidders to condition all of their bidding behavior on observations about bidding in the other auctions. This allows the maximal amount of information to be applied in the auctions where it matters most: the last auctions to close. For this reason, multiple rounds of sealed-bids will likely require less use of after-market trading than sequential auctions.

In particular, the "hold-up" problem, wherein one bidder obtains a part of an efficient aggregation and then tries to extort the holder of the remainder by charging a high price, will be less severe in simultaneous auctions. Any key piece to an efficient aggregation of licenses will tend to close late in the auction, and therefore after the information about the aggregation has already become clear. Thus the bidder willing to pay the most will win the license. In contrast, in sequential auctions it is possible for a bidder to buy a single license early and then have it become clear later that another bidder values it more, after that other bidder's purchases are made. Sequential auctions, thus, encourage this type of inefficient allocation of licenses to occur.

5. Auctions can be completed more rapidly

It seems reasonable to suppose that it will take approximately one business day per oral auction. This means that it will take ten years to allocate all the PCS licenses by sequential oral auctions.¹⁰ In contrast, even if it takes a month to run multiple rounds of sealed bids, the PCS auctions would likely be completed in less than one year.¹¹

¹⁰ Since there are 51 MTAs for Channel Blocks A and B, and 492 BTAs for Channel Blocks C, D, E, F, and G, the total number of oral auctions would be 2,562. At the rate of one auction every business day, these auctions would take ten years to complete.

¹¹ This assumes that the 30 MHz licenses each take a month and that each channel block of the remaining licenses takes two months, by auctioning half the BTAs at a time.

6. Encourages efficient geographic aggregations

In order to promote efficient aggregations of geographic regions, I recommend that the auctions for a given block of spectrum be carried out simultaneously. This permits bidders to make interdependent bids, and in particular to raise one bid given success in another auction. Oral auctions, which are necessarily sequential because a bidder cannot be in two places at once, permit bidders to base their bids in later auctions on the outcome of earlier auctions (see Notice at ¶ 51). Oral auctions will bias the outcomes towards particular kinds of aggregations, basically centered around the properties auctioned first, and discourage aggregations of properties auctioned late in the sequence (see Notice at ¶ 52).

In contrast, simultaneous auctions permit the bidders to bid aggressively on the aggregation of their choice, allowing the market decide which aggregations should arise. This appears important because some unusual but sensible aggregations of cellular licenses have arisen, such as the combination of licenses along major interstates held by GTE/Contel in the Southwest and McCaw/LIN in the Northeast. Moreover, given the somewhat "patchwork" nature of existing cellular licenses, it seems likely that cellular companies, seeking to fill out or complete regional areas, will bid aggressively on geographic aggregations that are difficult or impossible to predict in advance. These considerations lead to the conclusion that it is important to permit the market to choose the types of geographic aggregations that make good business sense rather than have the Commission attempt to predict these aggregations in advance of the auction.

Furthermore, using simultaneous auctions, bidders can aggressively pursue a subset of the licenses of their choice, without the threat of a hold-up problem that arises out of the accidental ordering of the licenses under sequential auctions. For example, if a national license is optimal, a bidder can keep bidding for all the MTAs until it has won

them all. Similarly, the auction facilitates aggregation of regional-sized licenses, the composition of which are determined by market forces and not by the auction form itself.

7. Provides more data for evaluation by Commission

In oral auctions, only the number of participants and the eventual winning bid become apparent. In contrast, multiple rounds of sealed-bids provide more information and will permit the Commission to perform a more complete analysis of the bidding. In particular, the Commission may observe that a particular applicant drops out of several auctions on the same round, and therefore be able to estimate what set of licenses that applicant was pursuing and at what point the prices of the licenses became too high for it. This will shed light on applicants' strategies in bidding on PCS, and provide a basis for the Commission to evaluate the sale's success at promoting efficient aggregations and for understanding the form of competition in the PCS market.

8. Increases expected government revenues

Multiple rounds of sealed-bids enhance government revenue over both oral and first-price, sealed-bid auctions. This is because multiple rounds of sealed bids release more information to the bidders, which enhances government revenue,¹² than either first-price, sealed-bids or oral auctions. First-price, sealed-bid auctions, of course, release no information. Oral auctions tend to release less information than multiple rounds of sealed-bids because typically at any moment only two bidders are involved in the actual bidding. Thus information about firms not currently bidding, as to whether they are willing or not to pay the current price, is unavailable. In contrast, using multiple rounds of sealed-bids,

¹² See Milgrom and Weber (1982), "A General Theory of Auctions and Competitive Bidding," *Econometrica*, 1982.

the Commission can choose to release *all* of the current bids, thereby releasing a maximal amount of information about the bidders' willingness to pay.

D. Advantages of the Proposed Auction Design Over the Use of Sealed Bids for a National License

As noted, the value of a license in one geographic area will likely depend on whether a given firm wins licenses in other geographic areas. This interdependency of the values of licenses in different areas raises the major issue of how to use the auction form to facilitate the assembly of efficient aggregations of geographic areas. A full solution to this problem would probably involve complete combinatorial bidding, i.e., allowing the bidders to bid on every possible geographic configuration of licenses. This solution has two serious defects. First, it is computationally prohibitive. In particular, there are 2,251,799,685,247 possible sets of MTAs on which a firm could bid. Second, it admits the possibility of perverse outcomes, known as *bullying equilibria*. A bullying equilibrium arises when some bidders have pessimistic, self-fulfilling beliefs. For example, firms may believe that no one will submit serious bids in the auctions for individual MTAs because those licenses will almost certainly be won by a bidder for a national license. As a result of what the Commission terms the *free-rider* problem (see Notice at ¶ 62), no bidder has an incentive to submit nontrivial bids for individual MTAs, because they can not unilaterally overcome bidding on a national license.

The Commission has proposed two combinatorial schemes: bidding on national 30 MHz licenses and bidding on MTA licenses for the other channel blocks auctioned individually at the BTA level. I will focus my discussion on the national license; the logic for the other channel blocks is analogous. Ignoring for a moment the free-rider problem, *the Commission's proposal makes sense only if a national license is likely to be the only important geographic aggregation in the auction*. If, in contrast, the efficient allocation is

a small number of large blocks (e.g., east and west), then facilitating a national license makes little sense and can lead to severely inefficient outcomes, even ignoring the free-rider problem, because the national license may sell even when it should not.¹³

To give a concrete example, suppose there are three firms, *E*, *W*, and *N*, and three licenses, East, West, and National. Firms' valuations of the licenses are as follows.

	East	West	National
Firm <i>E</i>	\$2.0 billion	\$1.0 billion	\$3.0 billion
Firm <i>W</i>	\$1.0 billion	\$2.0 billion	\$3.0 billion
Firm <i>N</i>	\$1.6 billion	\$1.6 billion	\$3.3 billion

Suppose first that there is no separate auction for the national license, rather all three firms bid for the East and West. The outcome of the auction for the East is that Firm *E* wins with a bid slightly in excess of \$1.6 billion, thereby exceeding firm *N*'s willingness to pay. Similarly, the outcome of the auction for the West is that firm *W* wins with a bid slightly in excess of \$1.6 billion. This outcome is the efficient one because the auction awards the licenses to the firms that have the highest valuations. That is, both firms *E* and *W* value the licenses at \$2 billion each, or \$4 billion in aggregate. Of this total amount, the government collects slightly in excess of \$3.2 billion from the proceeds of the auction.

Suppose now that a national auction were held, as well as the individual auctions for the East and West. Firm *N* has no incentive to participate in the East and West auctions, because it will win the national auction. In the individual auction for the East,

¹³ This is especially important in PCS auctions, where many of the potential bidders hold cellular licenses and therefore face large costs of participating in a national license auction (essentially being required to sell off their cellular operations).

firm *W* drops out at \$1.0 billion. Therefore, firm *E* has the highest bid, slightly in excess of \$1.0 billion. Similarly, firm *W* has the highest bid in the West, also slightly in excess of \$1.0 billion. In the separate national auction, firm *N* wins with a bid slightly in excess of \$3.0 billion, because firms *E* and *W* drop out at that price. Therefore, the price obtained for the national license exceeds the sum of the prices on the East and West auctions, and firm *N* wins the national license. Firms *E* and *W* obtain no licenses. This outcome is not efficient because the total value created is only \$3.3 billion (firm *N*'s valuation) rather than \$4 billion (firm *E*'s and *W*'s combined valuation). Moreover, the revenue to the government falls, compared to when there was no separate auction for a national license, from approximately \$3.2 billion to \$3.0 billion.

Now suppose, in contrast, that firm *N* values the nation at \$4.1 billion, i.e., more than firms *E*'s and *W*'s combined valuation of the national aggregation, and leave all other assumptions the same. If there were no separate auction for a national license, firm *N* would win both the East and the West auctions with bids slightly in excess of \$2 billion each. This outcome is the efficient one since the total value created (i.e., firm *N*'s valuation of \$4.1 billion) is maximized. Of this total value, the government would collect slightly in excess of \$4.0 billion. Thus, simultaneous bids for the East and West, with no separate auction for a national license, results in the efficient assembly of a national aggregation when that is the highest valued use of the spectrum. Finally, if there were a separate auction for a national license, firm *N* would win with a bid slightly in excess of \$3.0 billion, thus reducing revenue to the government.

This example is extreme to illustrate the problem with a national license in the most simple fashion. However, the logic of the example carries over to the more realistic case where the bidders are uninformed about the others' willingness to pay. To obtain efficient aggregation, the auction must permit bidder *N* to drop out of the individual auctions when the sum of prices reaches firm *N*'s willingness to pay, which requires the auctions to be simultaneous.

Finally, government revenue is typically higher with individual auctions. A firm bidding for a national license has little incentive to bid aggressively in the individual auctions, for by doing so, it makes its national bid less likely to succeed.

III. Recommended Auction Design

As described above, the basic form of the recommended auction is to employ several rounds of sealed bids in which all the geographic areas for a given spectrum block are auctioned simultaneously.¹⁴ In discussing the recommended auction design, I will use a 30 MHz license as an example. The other licenses can be auctioned in an analogous fashion. The auction proceeds by a series of rounds. Before each round and for each MTA, the Commission or its agent will announce:

1. the "minimum valid bid,"
2. the "suggested minimum bid,"
3. the list of bids received in the previous round, and
4. the due date for bids.

In the first round, any positive bid is valid. The "suggested minimum bid" in the opening round is an amount at which the Commission expects most licenses will sell. For example, suppose the Commission expects that most license rights will sell for \$0.30 per MHz per person in the MTA.¹⁵ For an MTA with a population of ten million, this would lead to a

¹⁴ Given that there are only 51 MTAs, it is feasible and useful to auction all 102 Channel Block A and B licenses in the 51 simultaneous MTA auctions. Such auctions would award the PCS licenses more rapidly and, by reducing the winner's curse, increase government revenues. The details of how these auctions would proceed are provided in Appendix C.

¹⁵ This dollar value equals half of the congressional estimate (see Notice at footnote 98). The minimum suggested bid should be revised based on the selling prices in the early

suggested minimum bid for a 30 MHz license of \$90 million = $\$0.30 \times 30 \text{ MHz} \times 10$ million. With respect to the bids received in the previous round, there are of course no bids to reveal in the opening round. I suggest that the bidders be given three business days to respond, so that the due date for bids is just the date of announcement plus three business days.¹⁶

Subsequent rounds proceed in a similar fashion. Having received the bids from the previous round, the Commission prepares a sheet listing the dollar values of the bids, *but not the identities of the bidders*. A sample sheet is provided in Appendix B. The "minimum valid bid" is the maximum bid from the previous round. The "suggested minimum bid" is the minimum valid bid plus an increment chosen to ensure rapid completion of the auction. I suggest that five percent might be a reasonable increment, trading off the desire to complete the auction rapidly with the desire to release information. Large minimum increments make the auction proceed in large steps, reducing the revelation of information.

The auction proceeds to the next round if at least two bidders submit bids as large as the suggested minimum bid. The auction also continues if no bidder submits a bid in excess of the suggested minimum bid, and there is a tie for the highest bid. Thus the auction can end in one of two ways:

1. No bids submitted,
2. Bids submitted, but less than two in excess of the suggested minimum bid.

auctions. For example, if it were found that 90 percent of the first 100 auctions produced prices in excess of \$0.45 per MHz per person, the suggested minimum bid might be revised upward to this value.

¹⁶ This time period could be lengthened or shortened depending on the Commission's preference in the trade-off between allowing applicants to deliberate and completing the auction expeditiously.

In the first case, with no bids submitted in the current round, the high bidder from the previous round is awarded the license at a price equal to her bid. The only exception arises in the first round; no one wins the auction in this case and the Commission retains the license. This exception should not arise unless the license is literally worthless, as otherwise some qualified bidder has the ability to submit a bid of one penny and win the license.

In the second case, the highest bidder in the current round wins the license at a price equal to that bidder's bid. In the event of a tie for the highest bid, with all bids strictly below the suggested minimum bid, the auction continues.

Winning bidders should be allowed to withdraw from winning a license, only forfeiting the \$0.02 per person per MHz up-front payment for a withdrawal, in order to avoid circumstances in which an applicant wins more licenses than it intended. This type of "regret" on the part of buyers is more likely to arise in sequential oral auctions than in multiple rounds of sealed bids. The reason being that in sequential oral auctions, bidders in one auction have no knowledge of how licenses in future auctions will be valued by other bidders. Whereas in simultaneous sealed-bid auctions, bidders can learn about other bidders' valuations and so form more accurate estimates of the values of the licenses on which they bid. The ability of buyers to more accurately estimate the values of licenses reduces the likelihood that they will either fail to acquire those licenses for which they have the highest valuation or pay too much.

If a withdrawal occurs, the winner of the auction is the second highest bidder. Notice that if the auctions had been oral as proposed by the Commission, a withdrawal would necessitate a second auction. By contrast, with the use of sealed bids, the second highest bidder can be readily observed and no new auction is required.¹⁷

¹⁷ The auction would only need to be re-opened in the unlikely event that two or more firms submitted identical, second highest bids.

Provided the suggested increment is small, withdrawals should be rare, because it is unlikely that too many auctions will close on the same round. Further, even when this occurs, it is likely that a given bidder will not have won more than it desired. Nevertheless, it is important to allow the bidders the flexibility to bid on several licenses when they only want one, in order to encourage aggressive bidding on all licenses. Moreover, the forfeiture of the up-front payment discourages bidders from using shell or dummy corporations to make multiple bids, hoping to withdraw some, since they must pay approximately their savings from a withdrawal.¹⁸ Finally, even when withdrawals occur, the government will likely lose little if anything from the withdrawal.¹⁹

With respect to the timing of when the simultaneous auctions will end, there is a simple strategy the auctioneer can follow to ensure that the auctions end approximately at the same time: make the size of the suggested increments depend on the number of active bidders. For example, if the increments were reduced to one percent when there were four bidders, one-half percent when there were three bidders, and one-fourth percent when there were two bidders, auctions would slow down before closing. This would tend to cause the prices for all of the licenses to be established at approximately the same time.

¹⁸ If the suggested increment were equal to the up-front payment, of course, it would never be profitable to use a shell or dummy corporation to submit a second bid. However, even with a five percent increment and a \$0.02 per MHz per person up-front payment, it will still not generally be profitable to utilize multiple bidders. The reason is that if a firm withdraws its winning bid, there were at least two bidders at the previous round, and thus a firm withdrawing a bid may not hold the highest bid from the previous round.

¹⁹ For example, assume that the market price is approximately \$0.60 per MHz per person (see Notice at footnote 98), and suppose the winning bidder drops out at this level. Then, with a five percent suggested increment, the previous bids were \$0.57 per MHz per person. Thus, when the winning bidder exits, the government obtains \$0.57 per MHz per person for the license, but also retains the \$0.02 per MHz per person up-front payment, for a total of \$0.59 per MHz per person. Requiring the bidder to pay the up-front payment leaves the government collecting approximately the same revenue as if the bidder had not withdrawn, yet gives the bidders the ability to withdraw from winning bids.

In sum, the recommended auction design represents a formalization of the way most very large private business transactions take place. Most transactions in the range of tens or hundreds of million dollars represent the sale of companies or divisions. Typically a small set of interested bidders is identified, which is analogous to the qualification process used by the Commission. Bids are solicited by the seller, generally the board of directors of the company being sold, and these bids are announced. New bids are then solicited which must exceed the maximum prior bid. Solicitation of bids continues until only one bidder remains.

Of course, private business is permitted to use informal selling procedures not available to the government. The recommended auction design mimics the way large corporations are sold within a simple set of rules that ensure an open and fair auction, avoiding the informal bargaining and discretion used in private sales. It is important to note that most private transactions in the tens of millions of dollars are *not* made in oral auctions, probably because consultation and deliberation are too important for obtaining a fair market price when the stakes are so high.

IV. Designated Entities

It is not uncommon for the government to wish to encourage the participation of some group by favoring them in auctions. There are two main methods used to implement such preferences: set-asides and price preferences (also known as bidding preferences or bidder credits). Set-asides are the more common method, while price preferences have primarily been used to favor domestic suppliers over foreign suppliers, both by the Buy American Act, which specifies 6-12 percent preferences, and also by the Department of Defense, which uses preferences of up to 50 percent. In addition, price preferences have been

frequently used in Canada, and to a lesser extent by other industrialized nations, to favor various groups.

Price preferences operate by permitting designated entities to bid lower and still win the auction. For example, suppose that small businesses are given a ten percent preference. If a small business bids \$1,000 and wins the auction, its payment to the government will be \$900 (i.e., 90 percent of \$1,000).

Price preferences could be applied to all of the auctions rather than to just a portion of them. One may view a set-aside as an infinite price preference applied to only a portion of the auctions. Price preferences have a number of advantages over set-asides.

1. Price preferences increase competition in all auctions

Designated entities are generally designated for favoritism because they are disadvantaged in some way. For example, small businesses may have difficulty competing because of capital constraints. Price preferences undo these disadvantages, making the designated entities more effective competitors in all of the auctions. In comparison, the use of set-asides typically means that only large businesses compete in the auctions not set aside, while only small businesses compete in the auctions set aside. In both cases, competition is increased by using price preferences. In the formerly set-aside auctions, there is participation by large business. In the auctions that were not to be set aside, there is more effective competition by small business. In both cases, a more competitive environment results.

2. Price preferences establish values for implementation of the unjust enrichment provision

One of the major issues raised by set-asides is how to deal with sales by designated entities to others (see Notice at ¶¶ 86 and 88). Typically what must happen is that the value of the license, were it not set-aside, must be estimated, and the difference between this value and the actual sale price estimated with the difference rebated to the government. Alternatively, the government may require the difference in the actual sale price and the amount paid rebated to the government, which effectively prevents resale no matter how valuable the exchange might be.

In contrast, a price preference creates a natural measure of the value of the license: the amount of the preference. Thus, if a ten percent preference were used, a sale of a license by a preferred group to a non-preferred group should carry a ten percent rebate to the government. That is, ten percent of the actual winning bid, for this is precisely the amount that the undesignated entity could have bid and won the license. Thus, thorny issues about exchange are handled naturally by price preferences.

3. Price preferences reduce inefficient sales

Set-asides put licenses in the hands of designated entities no matter how inefficient this might be. For example, a license worth \$10,000,000 to a undesignated entity could sell for \$10,000 under set-asides. With price preferences, such extreme disparities are not permitted. Price preferences allocate licenses to designated entities when these are sufficiently close in value, and not otherwise, where sufficiently close is determined by the magnitude of the price preference. Price preferences ensure that there is a minimal social loss associated with favoring the designated entity.

4. Price preferences increase government revenues

Price preferences maximize government revenue subject to the constraint that designated entities win a given portion of the licenses on average.²⁰ That is, there is no less expensive way to ensure a given level of participation by designated entities than price preferences.

In addition, price preferences may increase government revenue even when compared to no favoritism at all. This is because price preferences create more effective competition. That is, the government may collect more revenue using price preferences than if it ignored the designated entities.

5. Price preferences do not create "ghetto licenses"

Set-asides banish favored groups to particular set-aside licenses, which tend to be the less valuable and useful ones. By using price-preferences, disadvantaged groups have a chance of winning any of the licenses, bringing them more into the mainstream of wireless communication.

6. Price preferences are a versatile instrument

Unlike set-asides, it is possible to provide distinct preferences to various designated entities. For example, small business could be given a ten percent preference, while rural telephone companies that do not qualify as small business could be given a five percent preference. Thus, the level of preferences can be adjusted to encourage participation by a

²⁰ See McAfee and McMillan (1989), "Government Procurement and International Trade," *Journal of International Economics*.

variety of groups of bidders, in spite of the fact that promotion of one group may conflict with promotion of another group.

Moreover, the level of preferences can be adjusted to achieve the desired goals. Thus, if the designated entities are nearly competitive with the undesignated firms, then a small price preference will suffice to ensure that the designated entities win a portion of the contracts. On the other hand, if the designated entities are not so close to the undesignated entities, than larger preferences may be necessary.

7. Price preferences can be used for partial ownership

One issue that arises with minority-owned business is the extent to which set-asides really create minority participation in the auction. Minorities may have nominal control of a company, which is effectively controlled by non-minorities. A solution to this problem arises by having the size of the preference related to the percentage control.

For example, suppose minorities are given a twenty percent preference. Then a business with sixty percent minority ownership would be given sixty percent of the twenty percent preference, or twelve percent. The advantage to such preferences is to reward firms with greater minority participation by greater preference in the auction. Moreover, such a system can encourage minority participation even in firms controlled by non-minorities.

Furthermore, partial application of preferences for partially owned minority business permits the government to require a payment if the minority ownership level is reduced. For example, a firm that goes from sixty percent to forty percent minority ownership would rebate twenty percent of its preference to the government. If the preference were thirty percent, this would require a rebate of twenty percent of the thirty percent price preference, or six percent of the winning bid.

8. Disadvantage of Price-Preferences

The only disadvantage of price preferences is the difficulty of assessing an appropriate level of preference to implement a desired level of participation by the designated entities. This problem is solvable, either by experimenting with 10 MHz licenses, or by observing the sale without preferences of some 10 MHz licenses, and then calculating how closely the designated entities came to winning. If, for example, the designated entities bid on average ten percent less than the others, a preference of ten percent would be reasonable to level the playing field.

V. Experimentation and Evaluation

The large number of BTAs to be auctioned provides an opportunity to experiment with the form of the auction and observe which designs encourage efficiency and returns to the government. In general, experiments should compare similar properties, so that as many factors as possible are held constant. This will make the comparison as clear as possible. A *paired* experiment, for example, could consist of the auction of two 10 MHz licenses in the same BTA. Generally, comparing the results on BTAs that are similar in terms of population, geographic size, residential versus commercial land use, per capita income, and characteristics of surrounding areas would be desirable. If many factors differ between two auctions, the results of the experiment will be difficult to interpret. In addition, it is clearly desirable to begin the experiments with the lowest value licenses. This ensures that mistakes are less costly and that the knowledge gained from the experiments can be applied to the highest value licenses. Thus, the preliminary experiments should be conducted with auctions for 10 MHz licenses.

The auction design proposed in section III contains several characteristics that would benefit from experimentation. These include:

1. the increment for the suggested minimum bid;
2. the information released to bidders;
3. the initial suggested bid; and
4. the level of price preference.

The increment for the suggested minimum bid trades off the speed at which the auction is completed against the detail of the information released. Thus, a ten percent increment completes an auction before a five percent increment on average, but the ten percent increment yields coarser information regarding bidders' valuations of the item for sale. That is, bidders learn the values associated with bidders who drop out of the auction only to ten percent accuracy rather than to five percent accuracy. Also, a ten percent suggested increment increases the likelihood that the auction will end with a round of no bids and the winner being the highest bid in the previous round.

Auctioneers generally choose the increment based on the intensity of competition. If it appears that many bidders are willing to pay the going price, the auctioneer might use large increments such as 25 percent to increase the price rapidly to a point where few bidders remain. At that point, the auctioneer will decrease the increments to five or ten percent, and later to one or two percent as the auction nears completion in an attempt to extract the last dollar from the bidders.²¹ Thus, in addition to experimenting with the size

²¹ Note that the suggested minimum bid is a substitute for the auctioneer's behavior, because it induces a bidder to bid close to her value to stay in the auction when she would rather see if anyone else would drop out. For example, if a bidder valued a license at \$1,000,000, and the current price were \$900,000, a bidder might bid \$950,000 rather than a lower amount and risk losing the license because the smaller amount was less than the minimum increment.

of the increment, the Commission may want to experiment with using increments related to the number of bidders (see discussion in section III).

A second avenue for experimentation is the information released to the bidders. Clearly an ascending bid auction must release the maximum bid from the previous round. Releasing other information involves a tradeoff. Information about the other bids is useful in assessing the value of the license and reducing the winner's curse. However, information about the number of other bidders may reduce the level of the winning bid. Thus, the Commission could experiment with releasing only the maximum bid; releasing all the bids; and releasing the maximum and minimum bids in order to determine which information release yields the best outcomes.

A third avenue for experimentation is the suggested minimum bid for the opening round. Since this bid affects how quickly the auction closes, it would be useful to experiment with different criteria for determining this suggested bid.

Finally, the level of price preferences necessary to involve designated entities can be assessed by experimentation. A strategy in this regard is to auction twenty 20 BTAs (a large enough number to draw reliable statistical inferences) with no preference and 20 BTAs with a five percent price preference for designated entities. The outcome of these sales can be used to observe whether five percent is sufficient to obtain the desired level of wins by the designated entities. If not, then increase the price preference to ten percent and so on until the desired level of wins is obtained.

With respect to post-auction evaluation by the Commission, the use of multiple rounds of sealed bids offers a basic advantage over oral auctions. Namely, that much more information concerning bidders' valuations and bidding strategies will be available. This information will be useful for conducting future auctions and for permitting the Commission to determine the success of the auctions at setting competitive market prices for PCS licenses.

VI. Summary and Conclusions

Given the goals of simplicity, efficiency, and revenue, the licensing of PCS spectrum is best accomplished by simultaneously auctioning the licenses using several rounds of sealed bids. Simultaneity ensures that the auctions do the best job of creating efficient aggregations without the excessive use of after-market sales likely to arise with sequential auctions.

Oral auctions have three major defects when compared to auctions with several rounds of sealed bids. First, oral auctions are necessarily sequential, which makes efficient aggregation difficult. In particular, oral auctions raise the problem of correctly ordering the sales. This requires the seller to forecast the efficient aggregations, which seems impossible to know in advance. It is preferable to let the market choose the aggregations that make good business sense. Such market choice requires simultaneous bidding.

Second, oral auctions permit bidders to observe the identities of their competitors, raising the likelihood of implicit collusion by rivals. While explicit collusion is unlikely given the size of the bidding firms, exposing the identities of bidders is likely to lead to less intense competition than would arise with anonymous auctions.

Third, oral auctions reduce the ability of bidders to consult with management or consortium partners and eliminate the opportunity for careful deliberation in bidding. Thus, the speed at which an oral auction operates eliminates the major advantage of oral auctions over one-time, sealed-bids: The incorporation of information regarding other firms' bids into the bidding process.

The extra release of information, along with careful deliberation by the bidders in forming their bids, allowed by the recommended auction, will lead to (1) more efficient aggregations of licenses; (2) higher average prices for the licenses; and (3) more informed decisions by applicants, i.e., less regret. The recommended auction forces prices closer to the maximal values of the licenses, because the licenses are allocated more efficiently and

bidders need not fear serious overbidding. Additionally, PCS licenses will be awarded far more expeditiously, possibly years sooner, than would likely occur with sequential oral auctions.

Use of a separate national license to facilitate aggregation is both unnecessary and inefficient. With simultaneous ascending bid auctions, such a license can be readily assembled by a bidder. Furthermore, auctioning a national license separately is likely to lead to inefficient aggregation. The existence of the separate auction for a national license also reduces competition for the individual licenses, leading to lower prices.

In sum, the recommended auction design, with several rounds of sealed bids for the simultaneous sale of different geographic areas, is preferable to the Commission's two-part system of sequential oral auctions for different geographic areas in conjunction with a separate sealed bid for a national license.

Appendix A

Appendix B

FCC Bid Data Compilation Sheet
MTA 1 and Channel Block A

	Day 1	Day 2	Day 3	Day 4	...
Minimum Valid Bid					
Suggested Minimum Bid					
Bidder 1					
Bidder 2					
Bidder 3					
⋮					
⋮					
Maximum Bid					

Appendix C

1. Simultaneous Auctions of Channel Blocks A and B

As mentioned in section III, all the 102 Channel Block A and B licenses could be auctioned simultaneously with 51 MTA auctions. Such a series of auctions would more rapidly award the PCS licenses and yield more information to the bidders with which to estimate the values of the licenses. This section describes the modifications to the recommended auction design that would be necessary to implement the simultaneous auctioning of Channel Blocks A and B.

The first round of the auction is identical to the recommended auctions in which the Channel Block A licenses are sold for all 51 MTAs, followed by the Channel Block B licenses. The auction proceeds to the second round if at least *three* applicants submit bids as large as the suggested minimum bid. Thus the auction can end in one of two ways:

1. No bids submitted,
2. Bids submitted, but two or fewer in excess of the suggested minimum bid.

If no bids are received, then the two highest bidders in the previous round win the auction for Channel blocks A and B for a given MTA. The firm with the highest bid gets to pick whether it wants Channel Block A or B. Note that one firm cannot win both Channel Blocks because of the Commission's 40 MHz maximum.

If exactly two bids are submitted that exceed the suggested minimum bid, then these two applicants win the auction for Channel Blocks A and B for the given MTA. Again, the firm with the highest bid gets to pick whether it prefers Channel Block A or B.

If one bid is submitted that exceeds the suggested minimum bid, then this applicant and the second highest bidder win the auction for Channel Blocks A and B, and the applicant with the highest bid selects which of the two blocks it prefers.

Finally, if bids are submitted but none exceed the suggested minimum bid, then the two highest bidders win the auction for Channel Blocks A and B and, again, the applicant with the highest bid selects its preferred block.

In the case of ties, the tied applicants submit one final round of sealed bids to determine the winners.

2. Reserve Prices

It is quite common for sellers to impose reserve prices, or minimum acceptable bids. The imposition of an appropriate reserve price tends to force prices paid to be higher. The effect of a reserve price is approximately to add an additional bidder, i.e., the seller, to the pool of bidders, increasing the price paid when the competition is not very intense. Reserve prices also carry some risk that the license will not sell at all, when no bidder is willing to pay the reserve price. Viewed this way, it becomes clear that reserve prices are less important when there are many bidders.

While appropriately chosen reserve prices may increase the government's revenue, three factors mitigate against the imposition of a reserve. First, reserve prices operate by creating an inefficiency because in some circumstances the government may end up not selling the license even though a bidder was willing to pay something for it. Thus, the imposition of reserve prices conflicts with the goal of efficiency. Second, if the Commission will attempt in the future to sell all unsold license rights, or award them by lottery, the usefulness of a reserve price is undercut, because a buyer has the opportunity to wait until the next sale rather than pay the reserve price. This will tend to eliminate the effectiveness of the reserve in forcing prices up, while causing the Commission to incur the

additional transaction costs associated with resale. Finally, one of the main advantages of auctions is that they allow a seller to obtain a fair market price without knowing the demand. However, in order to implement an appropriate reserve price, the Commission would have to have assembled substantial information regarding demand. Thus, in imposing a reserve, the Commission risks imposing an inappropriate reserve, which might be worse than no reserve at all.

For these reasons, I agree with the Commission that it should not impose a reserve price (see Notice at ¶ 66-67). However, I recommend that the Commission impose *suggested* increments, as a way to encourage faster completion of the auction. Because such suggested increments are not binding, they do not operate like reserve prices, and in particular do not induce an inefficient outcome.

3. Royalties

A royalty is a payment made to the government by the winning bidder, generally a percentage of revenue, although percentages of profit are sometimes used. Appropriately chosen royalties can increase the revenue of the seller. Royalties are used in offshore oil sales and book publishing contracts. The equivalent of a royalty for a buying contract, called *cost-sharing*, is observed in procurement auctions.

Royalties increase the revenue of the government by two distinct means. First, royalties shift risk from the winning bidder to the government. Provided the bidders are more averse to risk than the government, this risk shifting or risk sharing has the effect of reducing the risk to the government. The associated cost of risk, the *risk premium*, accrues to the government (see Notice at ¶ 70). Second, royalties tend to "level the playing field" among the bidders -- bidders with a high value of a license will not be so much better positioned than bidders with a low value because the bidders with a high value must pay a larger royalty (a percentage of the larger value) to the government. This

makes weaker competitors relatively stronger and ensures a more competitive outcome to the auction.

Royalties create an inefficiency analogous to the inefficiencies created by taxation: the winning bidder retains a smaller portion of the revenues, and therefore has less incentive to develop the license fully. Thus, royalties trade off efficiency against revenue raising, and for this reason, I do not recommend their use in the PCS context.

Moreover, the base for royalties may be quite difficult to measure. It is preferable to impose the royalty on revenue associated with the license, which means revenue associated with the use of the spectrum. However, the price competition in cellular has focused on the pricing of equipment rather than the pricing of the airwaves. It is not uncommon to see the cellular phone virtually given away in exchange for a commitment to use a particular cellular provider for some period of time. This arrangement presumably serves the consumer well. Imposing royalties on revenue associated with the use of the spectrum may encourage firms to "play games" in attempting to avoid the royalties. For example, by charging a large price for the equipment and reducing the price of the airwaves. Such avoidance of royalties reduces the efficiency of the market and deters firms from serving consumers as well as they might.

Finally, royalties would require an army of accountants and auditors to ensure that firms pay the appropriate royalties and do not shift revenues from PCS to paging or cellular or other operations. Given the complexity of the wireless market, the ability of firms to shift revenues would likely create huge transactions costs in collection of the revenues, interfering with the efficiency of the market.

4. Risk Aversion

Because PCS spectrum is expected to sell for a large amount of money, firms may potentially gain or lose very large amounts of money. Therefore, the attitudes of the firms toward risk may be significant in determining the prices paid for PCS license rights.

Auctions present bidders with two types of risk: risk associated with the *winner's curse* and risk associated with whether one wins the auction or not. The risk associated with the winner's curse tends to favor ascending-bid auctions, because the release of information reduces the *risk premium*, or cost of risk, associated with participation in the auction, a dollar amount lost to the seller. However, risk associated with winning or losing the auction, ignoring *winner's curse* effects, tends to favor first-price, sealed-bid auctions. This follows because a slight increase in the bid tends to reduce the likelihood of losing, which is a tradeoff that a risk-averse firm is willing to make, at least starting from the bid which maximizes average profits.

Given the enormous uncertainty of the value of the licenses, risk associated with winner's curse effects may well dominate risk associated with winning or losing the auction. But on balance, it is impossible to say which auction form is preferred given aversion to risk by the bidders.

Risk aversion affects the efficiency of the auction insofar as the bidders have different levels of risk aversion. Typically, one might expect small firms to be more averse to large financial risks than large firms, as large firms have the resources to withstand larger losses. This may give large firms an advantage in bidding on the more valuable licenses. To some extent, the reduction of risk associated with ascending bid auctions may then favor small firms over the riskier first-price, sealed-bid auctions.

5. Second-Price, Sealed-Bid Auctions and a National License

The Commission suggests that a second-price, sealed-bid auction may solve the free rider problem associated with the use of a national license (see Notice at ¶ 62). This reasoning is incorrect. The use of second-price, sealed-bid auctions does not necessarily create efficient outcomes. The reason is that bidders for individual licenses no longer have an incentive to bid their estimated value of the license, even ignoring winner's curse effects. Formally, in a private values environment, where bidders know their own value, bidders in the individual auction have an incentive to *overstate* their actual values. The reason is that a slight increase in the bid over one's actual value has a negligible effect on profits conditional on outbidding the others for the individual license (since it produces a small probability of a small loss) but a non-negligible effect on the likelihood that the license is sold individually rather than as a group. Thus, the value revelation of the second-price, sealed-bid auction is destroyed by the use of the bids to determine whether to sell the licenses as a group. Nevertheless, the use of second-price, sealed-bid auctions may assist in permitting efficient assembly relative to other options, although it can not generally overcome the combinatorial problem short of using trillions of auctions.

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