

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

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

PP Docket No. 93-253

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

REPLY COMMENTS OF PACTEL CORPORATION

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SUMMARY

The large majority of Comments filed in this proceeding argue for the benefits of open bidding for broadband PCS licenses. Simultaneous auctions across all markets in a spectrum block provide the benefits of open bidding, while eliminating the disadvantages of oral sequential auctions. These disadvantages include: (1) auction ordering dilemmas which favor some bidders over others; (2) lack of information on later auctioned markets, resulting in less efficient pricing for all markets; (3) inability of bidders to incorporate new information into intelligent bidding strategies; (4) time required to complete licensing; and (5) risk of collusion. Simultaneous auctions need not involve complicated software or electronic access to implement.

Commentors also raised significant objections to combinatorial bidding for broadband PCS licenses, particularly nationwide bids. Simultaneous auctions make combinatorial bids unnecessary in that parties can aggregate any combination of markets they choose, without the inefficiencies, complexities, uncertainties and costs of combinatorial bidding.

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ATTACHMENT BY DR. R. PRESTON MCAFEE

NOV 29 1993

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Competitive Bidding)

Reply Comments of PacTel Corporation

PacTel Corporation hereby submits its reply comments in the above-captioned proceeding.

I. Introduction

In its initial Comments, PacTel recommended an auction design for broadband PCS licensing which has numerous advantages over the Commission's tentative proposal for oral sequential auctions combined with sealed combinatorial bids. PacTel proposed the use of multiple rounds of sealed bids in which all geographic areas for a given spectrum block are auctioned simultaneously.¹ PacTel's Comments set forth the benefits of such an auction design including efficient aggregation of licenses, speed of licensing, awards to the bidders which value licenses most highly, and greatest revenue to the government.²

In support of its recommendation, PacTel Comments included as an Exhibit a report from Dr. Preston McAfee who

¹Given the relatively smaller number of MTAs, all 102 licenses could be auctioned simultaneously. PacTel Comments Exhibit at 15, fn. 14, and 31.

²PacTel Comments at 1-5.

developed the approach recommended by PacTel. Dr. McAfee's report, based upon his wealth of experience in the design and use of auctions, provides the Commission with a sound basis for adopting simultaneous open, ascending bid auctions.³

Dr. McAfee has reviewed all the Comments filed to date in this proceeding and has developed a discussion paper responding to many of the arguments raised by other parties. That discussion paper is attached ("McAfee Attachment") to these Reply Comments.

II. Simultaneous Auctions Provide Significant Advantages Over Sequential Auctions.

Parties promoting the use of open bidding in simultaneous markets included NTIA⁴, Pacific Bell⁵, and NYNEX.⁶ TDS recommended such an approach for BTAs,⁷ and AT&T recommended that while oral bidding should be used during the early stages of competitive bidding, Commission experimentation with simultaneous bidding could provide efficiency benefits.⁸ These parties recognized the advantages of open bidding in multiple markets including

³See PacTel Comments Exhibit, Appendix A containing Dr. McAfee's Curriculum Vitae.

⁴NTIA Comments at 14.

⁵Pacific Bell Comments at 11.

⁶NYNEX Comments at 13.

⁷TDS Comments at 11.

⁸AT&T Comments at 15.

efficient allocation of bidders' resources, market-driven aggregation of licenses, and maximum information release.

A. Parties Supporting Sequential Auctions Reveal the Bias Inherent in this Approach, Are Unrealistic about the Time to Complete Licensing, and Fail to Appreciate the Increased Risk to Bidders.

1. Bias and Regret

One of the major problems posed by conducting auctions sequentially is how to determine the order in which licenses will be auctioned.⁹ Information revealed in later auctions will not be available to bidders in the early auctions, leading to inefficient pricing for the earliest auctioned properties, and buyer's remorse.¹⁰

Parties supporting sequential auctions recognize this risk and propose a variety of orders of licensing which will favor their particular strategy. Examples include proponents of largest to smallest population centers¹¹ smallest to largest population centers,¹² and east to west or visa versa.¹³ Rather than bias the outcome in favor of

⁹PacTel Comments Exhibit at 8.

¹⁰McAfee Attachment at 7-8.

¹¹AT&T Comments at 9, Bell Atlantic Attachment at 14, TDS Comments at 8, GTE Comments at 5.

¹²MCI Comments at 11; Wisconsin Wireless Communications Corp. Comments at 1; U.S. Intelco Networks at 9; AWCC Comments at 39, opposing largest to smallest because "this manner would enable wealthy firms to dominate the largest markets in the nation in such a way that smaller entities will not be able to compete.

¹³SWB at 35; CCI Comments at 4.

some bidders by the specific ordering of sequential auctions, the Commission should implement simultaneous auctions, thus letting the market determine which licenses will close earliest. Furthermore, by using declining bid increments as the number of bidders fall off, auctions will tend to end at about the same time, thus minimizing the advantages of "early" or "late" license winners.¹⁴ The result will be fewer post-auction transactions, because more efficient (and likely comparable) prices will be established for all markets, thus minimizing buyer regret.¹⁵

2. Speed of Licensing

Parties supporting sequential auctions have unrealistic expectations about the timeframes in which all PCS licenses would be awarded.¹⁶ First, the sheer logistics of signing bidders in, checking qualifications and bid deposits, conducting the auction, and clearing the room will be time consuming. Bidding may go more slowly than anticipated, with parties unwilling to escalate the bidding beyond any minimum increments required in order to reveal more information than they need to reveal. The fact that oral auctions are familiar and tested with such items as "art,

¹⁴pacTel Comments Exhibit at 18.

¹⁵McAfee Attachment at 7-8.

¹⁶See e.g., McCaw Comments at 1: "Oral auctions are the best and most efficient means of ensuring that licensed services will reach the greatest number of Americans in the shortest period of time." (Emphasis added); TDS Comments Attachment at 20, proposing that four MTA auctions could be held each day.

valuable antiques, and real estate properties"¹⁷ does not mean that licenses worth hundreds of millions of dollars will sell in minutes. Indicative of the complexity involved in bidding on MTA licenses in an oral setting, TDS has recommended team bidding and the use of computer equipment in the room to facilitate "intelligent" bidding.¹⁸

Second, even if a number of licenses could be auctioned in a single day, to rush through licensing of numerous MTAs deprives bidders of the ability to incorporate the information learned in the previous auction to the subsequent one. With no time to reconsider bidding strategy or license values, bidders will lose key benefits of open bidding.¹⁹ The alternative, which is to give bidders time to deliberate between each auction, will result in huge delays in completing PCS licensing when conducted one at a time. Simultaneous auctions conducted over a period of weeks permits both deliberation and rapid completion of the process.

¹⁷CCI Comments at 2.

¹⁸TDS Comments at 23. In fact, oral bidding will inhibit bidders from intelligently utilizing information gained during the auction, thus undermining the primary advantage of an ascending bid auction. PacTel Comments Exhibit at 7.

¹⁹See McAfee Attachment at 4.

3. "Stopping Rules" and Withdrawal Issues

Commentors proposed a variety of "stopping rules" for simultaneous auctions.²⁰ PacTel's proposal, to end an auction for a particular license when a single bidder remains,²¹ is preferable to an approach which keeps every auction open to all bidders as long as any auction is open. The problem posed by this approach is that bidders are unable to assess at any time what licenses they have already won, since at any point another party can come in and reactivate bidding.²²

A related issue concerns the ability of bidders to be sure of winning one license prior to committing to another. Commentors raised fears that in simultaneous auctions, bidders won't know what value they place on certain markets unless they already know the outcome of previous markets.²³ This risk is really much greater for the early licenses in sequential auctions.²⁴ Intelligent bidding requires knowledge about license values in all the markets a party might be interested in pursuing, with the ability to withdraw, by forfeiting the up-front fee, if certain interdependent markets are not also won as expected.

²⁰TDS Comments Attachment at 15; Pacific Bell Comments Attachment at 19.

²¹PacTel Comments Exhibit at 16.

²²See McAfee Attachment at 8 for a full discussion of stopping rules.

²³Cox Comments at 5; TDS Comments Attachment at 13.

²⁴See McAfee Attachment at 7.

B. Simultaneous Auctions Need Not Involve Complicated Software or Computerized Bidding.

Two parties proposing simultaneous auctions, NTIA and NYNEX, recommend the use of computerized or electronic bidding.²⁵ While the use of computerized bidding is an option with which the Commission may want to experiment in future license auctions, PacTel recommends against adoption of electronic auctions for broadband PCS because of the potential for bidder confusion, software errors, and delays in establishing such a process.²⁶ This view was also supported by Professors Milgrom and Wilson in their affidavit attached to Pacific Bell's Comments: "[W]e have been mindful of the need to avoid relying on sophisticated new software, which might not be adequately developed and tested in time to conduct the auction next Spring."²⁷

PacTel's "low-tech" proposal (written or faxed bids) thus addresses a major fear raised by parties in this proceeding: that simultaneous auctions necessarily require implementation of a process akin to the New York Stock Exchange. Under PacTel's proposal, multiple rounds of written bids can be filed without any complicated equipment.

²⁵NTIA Comments at 14, NYNEX Comments at 15.

²⁶See McAfee Attachment at 16.

²⁷Pacific Bell Attachment at 21.

III. The Record Provides Overwhelming Support for Open, Ascending Bids, but Written Rather than Oral Bidding Should Be Utilized.

Parties supporting oral auctions in many cases were specifically supporting open auctions, i.e., the ability to top an existing bid.²⁸ These advantages apply to any open bidding process in which bidders can submit new bids in response to competing bids. A primary benefit of oral auctions was further identified as the value of "allowing bidders to act upon the most currently available data in determining the amount they are willing to bid for a particular license."²⁹ Open bidding in a written, simultaneous process enhances this benefit, in that the values attributed to all the licenses in a given block are revealed, thus greatly increasing the information available to each bidder.³⁰

Additionally, oral auctions reveal the identity of the bidders for a given license.³¹ This increases the

²⁸See, e.g., Paging Network Comments at 13; GTE Comments at 5: "In contrast to sealed bidding, . . . oral sequential auctions allow each competitor to judge whether or not to continue in the auction"; SWB Comments at 16, citing advantages of oral auctions including lower private costs because no estimation of other bidders' strategies is needed, and fairness because process assures bidders willing to pay enough can be assured of winning; Telocator Comments at 3.

²⁹AT&T at 12; see also SWB Comments at 18. "The advantage of the increased information provided by oral auctioning cannot be underestimated."

³⁰See NYNEX Comments at 15.

³¹Telocator Comments at 3.

likelihood of implicit collusion which would reduce winning bids. Also, the presence of better informed, "deep pockets" bidders will typically discourage others from aggressively participating in the bidding, thus guaranteeing that the informed bidder obtains the object at a low price.³²

Finally, PacTel disagrees with those parties who claim that oral auctions "should impose the fewest costs on both applicants and the Commission."³³ Rounds of written bids impose far fewer costs in saved travel time for applicants and saved processing time for the auctioneer who must repeat the oral process hundreds or thousands of times.³⁴

IV. Combinatorial Bids Do Not Result in Efficient Allocation of Licenses.

A. The Commission Proposal for National Combinatorial Bid Was Strongly Opposed by Commentors.

Strong opposition to combinatorial bidding by the commentors in this docket included a broad range of practical, economic, legal, and public interest rationales for rejecting combinatorial bidding for a national license. Arguments against a national combinatorial auction include the inability to create rational aggregation schemes;³⁵ the

³²McAfee Attachment at 11.

³³McCaw Comments at 5.

³⁴See JMP Comments, Para. 3 opposing oral bidding for designated groups who may not have the necessary manpower to participate in oral spectrum auctions.

³⁵BellSouth Comments at 6; Telocator at 5.

introduction of unnecessary complexity;³⁶ contravention of statutory requirements for diverse participation and attention to regional differences;³⁷ significant additional costs to prepare for and participate in PCS auctions;³⁸ and a bias toward anticompetitive national services.³⁹ Parties also addressed the inefficiencies created by the "free-rider" problem, in which the existence of the combinatorial bid discourages bidders from increasing their individual MTA bids by letting the burden fall on other bidders.⁴⁰

MCI proposes a combinatorial bid process which utilizes second priced sealed bids for the national license.⁴¹ As explained by Dr. McAfee, the MCI proposal exacerbates the free-rider problem by insuring that a national license not only sells in circumstances where it is valued significantly

³⁶McCaw Comments at 11. For an example of complications which are associated with combinatorial bids, see CCI Comments at 4-8.

³⁷SWB Comments at 24; GTE Comments at 8.

³⁸PageNet Comments at 21.

³⁹APC Comments at 4.

⁴⁰Pacific Bell Comments Attachment at 8. See also McAfee Attachment at 14 for a fuller discussion of the free rider problem: "This proposal is not solved by CTIA's proposal to announce the combinatorial bids prior to the individual auctions. . . ."

⁴¹MCI Comments at 8. MCI's arguments with regard to cellular eligibility out-of-region are not germane to this proceeding. The Commission has already ruled on that issue in GEN. Docket No. 90-314; Second Report and Order, Released October 22, 1993, Para. 106.

less than the licenses are valued individually, but sells at a lower price as well.⁴²

B. Full Combinatorial Bidding is Unworkable and Inefficient.

Several parties advocated full combinatorial bidding that would permit bidders to express the interdependencies of license values by creating unlimited subsets of the licenses for bidding purposes.⁴³ This approach should be rejected.

First, the free-rider problem identified above persists even when all combinations are allowed. Second, the potential number of combinations would result in hundreds of thousands of auctions taking place simultaneously. This creates incentives for abuse by bidders to "game" the system and come up with complicated and clever combinations in order to confuse other bidders and defeat their combinations.⁴⁴ Furthermore, complex software and expensive systems would be needed by the Commission just to keep track of who is winning the auctions. Finally, full combinatorial bidding is simply unnecessary with simultaneous auctions in which bidders can submit bids on the specific aggregation of licenses they desire by submitting the highest bids for each individual license.

⁴²McAfee Attachment at 12.

⁴³Ameritech Comments at 4; NTIA Comments at 15; CTIA Comments Attachment at 8; NYNEX Comments at 14.

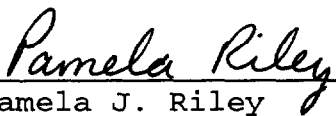
⁴⁴See McAfee Attachment at 15.

V. Conclusion

As set forth above, simultaneous auctions of PCS licenses within spectrum blocks using multiple rounds of sealed bids best serves the Commission's objectives. Such auctions will be simple to administer, quick to conclude, resistant to collusion, and establish a rich record for analysis. Most importantly, simultaneous open bidding will result in the most efficient allocation and aggregation of licenses, minimizing bidder regret, maximizing government revenues, and maximizing consumer welfare.

Respectfully submitted,

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November 24, 1993

**PacTel Exhibit
in PP Docket No. 93-253**

Auction Design for Personal Communications Services: Reply Comments

by

R. Preston McAfee

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

University of Texas at Austin

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Executive Summary

The best practical manner in which to auction spectrum license rights for Personal Communication Services is to use several rounds of sealed bids in which all geographic areas for given spectrum blocks are auctioned simultaneously. Simultaneous, ascending bid auctions are preferable to the oral, sequential auctions supported by several of the respondents to the Commission's Notice of Proposed Rule Making. First, simultaneous auctions permit the market rather than an auction design with an arbitrary sequence of licenses to determine which aggregations of licenses make good business sense. Second, simultaneous auctions can be completed more quickly and will generate more revenue. Third, simultaneous auctions provide bidders with more information with which to estimate the values of the licenses, and they permit careful consultation with management or consortium partners. Finally, the identities of the bidders can be kept secret, reducing the likelihood of implicit collusion.

A separate auction for a national license, as advocated by some respondents, is both unnecessary and inefficient. A national collection of geographic areas can be readily assembled by a bidder in an auction with several rounds of sealed bids. A separate auction for a national license also increases the likelihood of inefficient aggregations of licenses; reduces prices paid for individual licenses; and needlessly complicates firms' bidding strategies.

The Commission should also reject the use of full combinatorial auctions, which are advocated by some respondents. Such auctions will require the development of new computer software and force bidders to make complex calculations in potentially hundreds of thousands of auctions. Full combinatorial auctions are computationally prohibitive and also will lead to inefficient aggregations of licenses.

I. Introduction

My name is R. Preston McAfee. I am the *Rex G. Baker, Jr.*, Professor of Political Economy at the University of Texas at Austin.¹ At the request of PacTel Corporation ("PacTel"), I developed a recommended auction design for personal communication services ("PCS") that was submitted to the Commission in conjunction with the *Comments of PacTel Corporation*, November 10, 1993.² I have been asked by PacTel to review and respond to the auction design aspects of the comments submitted by the various interested respondents to the Commission regarding its Notice of Proposed Rule Making ("Notice"), dated October 12, 1993.

In my opinion, the best practical method to conduct the auctions for PCS license rights is to use several rounds of sealed bids in which all geographic areas for given spectrum blocks are auctioned simultaneously. This auction design will enable the Commission to achieve the goals of efficiency, simplicity, and revenue. The virtues of simultaneous over sequential bidding are described in my prior report (see *PacTel Auction Design Comments* at 6-12) and in the comments of others and can easily be summarized. Simultaneous auctions do not force an arbitrary sequence of auctions to determine which licenses are aggregated. Instead, the market determines which aggregations of licenses make good business sense. Simultaneous auctions can be completed more quickly than sequential auctions, which at the rate of one auction per business day will take ten years to complete. Simultaneous auctions provide bidders with

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 R. Preston McAfee, *Auction Design for Personal Communications Services*, November 10, 1993 ("PacTel Auction Design Comments").

information about the values of all the licenses rather than just the licenses that have been previously auctioned. The use of repeated rounds of sealed bids also allows bidders to undertake careful consultation with management or consortium partners in making their decisions as to how to bid on licenses that may be worth hundreds of millions of dollars. Finally, the identities of the bidders can be kept secret, unlike in oral auctions, reducing the likelihood of implicit collusion and preventing the possibility that small bidders will choose not to bid against well-informed, deep-pocket bidders.

I have reviewed the comments on auction design submitted by the respondents to the Commission's Notice. Their comments can be summarized as follows: (1) a number of the respondents favor oral sequential bidding, but advocate that the auctions be ordered in conflicting sequences; (2) there is strong opposition to the Commission's proposed nationwide, combinatorial auction; (3) a number of respondents favor aggregation of licenses with smaller than national market configurations; and (4) several respondents, supported by auction experts, argue against sequential auctions and in favor of simultaneous or, alternatively, full combinatorial auctions.

The remainder of this report is organized as follows. Section II discusses the comments of the respondents on the subject of sequential versus simultaneous auctions. Section III analyzes the comments as they relate to whether ascending bids should be made orally or with several rounds of sealed bids. The views of the respondents on the subjects of a separate national license and full combinatorial bids are discussed in sections IV and V, respectively. The summary and conclusions are contained in section VI.

II. Sequential versus Simultaneous Auctions

A. Ordering of Auctions

Several respondents, including AT&T, Bell Atlantic, GTE, Southwestern Bell, MCI, Cox Enterprises, and others support the use of sequential oral auctions. Sequential auctions bias the bidding in favor of some firms over others, such as large firms over small firms and possibly bidders for licenses auctioned early over bidders for licenses auctioned later. Proponents of sequential auctions naturally disagree on the appropriate order in which the auctions should be held. This is not surprising because the order in which the auctions are held will influence their outcomes. As a general rule, the larger companies favor an ordering of largest to smallest MTAs, because the larger firms would like to purchase the larger market areas prior to bidding on peripheral licenses. Smaller firms, in contrast, generally favor a smallest to largest ordering since they want to bid on smaller areas independent of their value as complements to larger areas. Southwestern Bell and Cellular Communications favor a geographic ordering of east to west or west to east. Finally, while NYNEX favors simultaneous auctions, their experts propose *randomizing* the ordering of the auctions if sequential auctions are used. Cellular Service also proposed a randomized ordering.

As the respondents recognize, if sequential auctions are used, the ordering of the auctions is extremely important, and gives major advantages to some bidders over others.³ In contrast, simultaneous auctions eliminate the bias by letting the market decide the order in which the auctions close. This eliminates any preference for one type of firm

³ Randomizing the ordering, as proposed by NYNEX's experts, Professors Harris and Katz, does not eliminate the bias. Randomization merely makes the bias created by the order random. Thus, while it will be impossible to say which firms are favored until the ordering is chosen, the ordering will in fact favor some firms and disadvantage others, and therefore does not cure the bias problem.

over another. Most significantly, simultaneous auctions favor the firms willing to pay the most for the licenses, which is the efficient auction outcome.

Several of the comments indicate that sequential auctions facilitate aggregation. In particular, Paging Network, Southwestern Bell, and Bell Atlantic make such arguments. It is important to understand that sequential auctions facilitate efficient aggregation *only in comparison to one-time, sealed-bid auctions*. Simultaneous auctions, however, encourage more efficient aggregation compared to sequential auctions.⁴

B. Time Required to Complete the Auctions

Respondents favoring sequential auctions presume that these auctions can be carried out quickly. This is misguided. As I have previously indicated (see PacTel Auction Design Comments at 9), sequential auctioning of MTAs, BTAs, and channel blocks at the rate of one per day would take ten years. Although it may be physically feasible to auction both the New York and Los Angeles MTAs on the same day, it would be a serious mistake for the Commission to auction these licenses sequentially in just one day. The problem with auctioning important properties on the same day is that doing so would prohibit a bidder from effectively incorporating information from the first auction into the second. Careful deliberation requires time for financial analysis and to plot and re-evaluate one's strategy. The main advantage of oral auctions, i.e., the incorporation of information about other bidders' strategies and bids, is lost if the auctions occur rapidly (see PacTel Auction Design Comments at 6-12). Thus with sequential auctions, either much of the

⁴ Bell Atlantic's experts, Professors Bulow and Nalebuff, have taken a position which is difficult to comprehend in this regard. They realize the importance of simultaneity, but encourage it *only on distinct channel blocks for a given geographic unit*. Thus, they would simultaneously sell channel blocks A and B for the New York MTA, but not simultaneously sell the New York MTA and the Los Angeles MTA. Their position is difficult to justify.

information from previous auctions is discarded because of the speed of the auctions, or the auctions take an unreasonably long time to execute. In contrast, simultaneous auctions with several rounds of sealed bids provide time to re-evaluate bids in light of new information, yet finish quickly because many properties are auctioned simultaneously.

Telephone and Data Systems ("TDS") and their expert, Professor Weber, claim that it is possible to hold all 104 auctions for the 30 MHz licenses in a matter of weeks. This requires auctioning four licenses per day. Their proposal calls for

- (i) auctions to close if no bids are received for five minutes,
- (ii) a ten minute break between auctions, and
- (iii) up to five individuals per bidding firm in the auction room.

This proposal, while it may force the auctions to end relatively rapidly, does not promote the careful deliberation and thoughtful bidding necessary to obtain efficient outcomes. It is questionable to assume that a firm will allow even five individuals the financial flexibility necessary to adjust a half billion dollar bid, because new bidder information indicates that the license is worth more to others than was originally thought.

For example, suppose that a firm initially estimated that the New York MTA is worth \$450 million, and authorized its bidders to bid up to this amount. Similarly, it estimated the value of the Los Angeles MTA to be \$350 million and authorized a bid up to this amount. During the course of the first auction, suppose New York sells for \$700 million, and unexpectedly there were four bidders willing to pay over \$500 million. This is new information, which rationally should be incorporated into the firm's bid on Los Angeles. The bidders get a *ten minute* break in which to call management, attempt to answer the question "Why were these firms willing to pay so much?," and decide whether to increase their maximum bid for Los Angeles.

Bidding on New York shows the firm that its method of valuing the licenses is not in accord with the way the other bidders value the licenses, since it did not anticipate such aggressive bidding in New York. This is important information and TDS' timeline gives the firm only ten minutes to incorporate it and determine a new maximum bid level. Ten minutes to make hundred million dollar decisions is unrealistic and will lead to substantial regret on the part of bidders. Even an entire day is insufficient, because the firm must re-evaluate its method of valuing the licenses. The presence of bidder regret that would result from TDS' proposal would be observable in the after-market, when many firms trade license rights because of the inefficient allocation caused by the sequential oral auction design. The end result of forcing such decisions to occur in minutes will be that bidders are not given the flexibility to incorporate information from the auctions into their bidding strategies. This inability to incorporate information exacerbates the "winner's curse," which reduces average prices for the licenses.

In contrast, an auction design with several rounds of sealed bids permits careful deliberation by the bidders and yet completes all the auctions in a timely manner. Because the 104 MTAs are auctioned simultaneously, even if there is a three business day lag between bids, the auctions should end in approximately one month.

Professors Bulow and Nalebuff, writing on behalf of Bell Atlantic, use a questionable approach to solve the problem of sequential auctions requiring a substantial period of time to complete: they call the 51 MTA auctions a "single" auction. Describing 51 auctions as "one" auction, however, does not allow the auction to proceed more rapidly. The Commission is still faced with either rushing through the auction of billions of dollars worth of licenses, or waiting several years for the deployment of PCS.

C. Bidder Regret and Withdrawal of Winning Bids

TDS, Paging Network, and Cox Enterprises claim that simultaneous bidding will create complications associated with the withdrawal of bidders. This is incorrect. Withdrawal is a problem only when bidders regret bids they have made. Simultaneous auctions reduce regret relative to sequential auctions. With sequential auctions, early licenses sell at prices not influenced by the bidding on later licenses. In light of bidding on later licenses, early licenses may have been very inexpensive or much too expensive. Either situation creates regret. In contrast, with simultaneous auctions, prices on all licenses are established simultaneously, thus reducing regret.

Sequential auctions also confound bidders attempts to pursue "secondary" or "fall-back" strategies. Consider a bidder who would like to acquire a number of MTAs in the Midwest, unless they are too expensive, in which case the bidder would like to acquire a number of MTAs in the South. With a sequential auction in which the MTAs are sold from largest to smallest by population, the bidder cannot bid on one area and then switch to the other area because some of the licenses in each area will have already been sold. For example, by the time it becomes apparent that the Midwest licenses are too expensive, Atlanta and other large southern MTAs will have sold.

Similarly, selling the licenses in a geographic ordering such as east to west, as proposed by Southwestern Bell, does not cure this problem. Some bidders will be forced to pursue their "fall-back" strategies first. For example, the bidder whose primary strategy involves the Midwest, but maintains a secondary strategy for the South, is forced to bid on the southern MTAs first. In contrast, under simultaneous auctions, the bidder may switch to the southern MTAs when the midwestern MTAs become too expensive.

An important advantage of simultaneous auctions is that a bidder has a good idea of the cost of the total package of licenses on which it is bidding while the auctions are still open. This allows the bidder the flexibility to pursue "fall-back" strategies.

Reducing the potential for bidder regret also reduces the "winner's curse." This reduction in the "winner's curse" tends to increase (on average) prices paid for the licenses and permits the market to determine which aggregations of licenses make good business sense. Reducing the scope for bidder regret also minimizes the likelihood that bidders will wish to withdraw winning bids.

The ability to withdraw insures the bidders against winning too much, permitting them to follow aggressive strategies. Finally, even when bidders do withdraw winning bids, the government is effectively insured against losses because what the government loses in revenue from awarding the license to the second-highest bid, it approximately gains in the forfeited payment. See PacTel Auction Design Comments at footnote 19.

D. Rules for Ending the Auctions

The experts retained by Pacific Bell, Professors Milgrom and Wilson, propose to auction licenses simultaneously and keep all the auctions open until there is no new bidding on any license. In addition, they proposed that bidders who wish to withdraw from any single winning bid are eliminated from obtaining any licenses at all. Effectively, any bidder desiring to withdraw on one license is forced to withdraw from participation in the auction, forfeiting the up-front payment on all licenses.

While I am sympathetic with the attempt to leave all the auctions open, such Draconian penalties for withdrawal create difficulties for the auction to actually incorporate the values of the bidders. The ability of a dormant license to suddenly erupt into bidding further exacerbates the problem. Under both my proposal and that of Professor's Milgrom and Wilson, bidders must bid more than their valuation of the licenses as independent licenses in order to acquire more valuable aggregations of licenses. Under the Milgrom-Wilson proposal, if a bidder fails to acquire the aggregation of its choice, perhaps because one of the licenses has become unexpectedly expensive, it

is faced with the choice of either exiting the auction and forfeiting all of its up-front payments, or purchasing remaining licenses at a loss. In contrast, the auction design recommended here would allow bidders to exit particular auctions, forfeiting only the up-front payment for those particular auctions. The advantage of this is that bidders can take a risk attempting to assemble an aggregation of licenses, knowing that if it fails to achieve the aggregation, it can withdraw from the other acquired licenses at a relatively small cost, i.e., the up-front payment on those particular licenses.

The basic economic point is that it is desirable to encourage bidders to take some risks attempting to put together aggregations of licenses, i.e., to bid more than these licenses are worth alone. Professors Milgrom and Wilson would penalize this behavior heavily. In contrast, the auction design recommended here encourages this behavior.

To understand the problem, consider a bidder who currently has the high bids, at \$15 each, on two licenses, A and B. Assume these are worth \$20 each by themselves, and \$50 together. Given that the bidder wins license A, license B is worth \$30 to this bidder, and the bidder could be forced by competition to pay, say, \$29 for license B. If at this point the auction for license A suddenly becomes active, similar reasoning says that the bidder would also pay \$29 to keep A.⁵ Thus, the bidder might, by the sequencing of auctions, be forced into paying \$58 for a pair of licenses worth \$50. No rational bidder will let this happen with high probability, but the way a rational bidder avoids this problem is to drop out of the bidding well before the prices reach the full value of the license, for fear of the holdup possible if some currently inactive licenses suddenly become active.

In contrast, the auction design recommended here allows the bidder to withdraw from the license at a cost equal to the up-front payment for that license. This lowers the

⁵ This assumes that the bidder holds B at \$29. Under the proposal of Professors Milgrom and Wilson, it is very difficult for the bidder to back out of this state of affairs.

risk of aggressive bidding without cost to the government, which collects the up-front payment and sells the license for slightly less. In addition, the recommended auction design (see PacTel Auction Design Comments at 16-17 and 31-32) stops inactive auctions permanently, therefore letting a bidder lock in a piece of an aggregation, which protects that bidder from further price increases in that license. Thus, under my proposal, the unexpected restarting of bidding on license A is not possible. The proposed stopping rule described in my previous report (see PacTel Auction Design Comments at 16-17 and 31-32) permits bidders to express the combination value of a group of licenses in the individual bids, without substantial risk of being forced to pay too much.

Of course, to exploit the full value of simultaneous auctions, it is important to have all the auctions open at the time when they approximately reach their final prices. The auction design recommended here accomplishes this by slowing down the rate of increase in prices as the auctions near termination, by making the bid increments smaller when there are fewer bidders. Thus, auctions that will eventually produce higher prices run at a relatively rapid pace, while auctions that are about to close, because competition has been narrowed to two or three interested bidders, slow down. This ensures that, as the prices converge to their final levels, a point is reached when prices are close to their final prices, but most or all of the auctions remain open.

III. Oral versus Repeated Sealed-Bid Auctions

The benefits attributed by many respondents, including AT&T, Cellular Telecommunications Industry Association ("CTIA"), and others, to *oral* auctions actually apply to any ascending-bid auction. These advantages include revision of bids in light of bidding behavior by others, and the perception of openness. The ascending bid auction advocated here possesses all of the advantages of the oral version of the auction, but

permits simultaneity of the auctions, time to consult between bids, and concealment of the identity of the bidders, in contrast to oral auctions.

As oral auctions are necessarily sequential, they create all the difficulties associated with sequential auctions. Several respondents request that the bidders' identities be kept secret, and although this is clearly a good idea, it is not enough. Oral auctions will still tend to release information about the identities of the bidders, even when the Commission takes steps to conceal their identities. In addition, "deep-pocket" bidders may want to reveal their participation, hoping to deter others from participating, on the principle that winning against certain bidders (e.g., better informed and wealthier bidders) typically means paying too much.

Consider, for example, the position of a bidder who know that a well-informed, deep-pocket bidder has a high willingness to pay for a particular license, but that the exact value of the license is not known by any bidder. In deciding whether to bid against such a deep-pocket bidder, the first bidder understands that if she were to win an auction in which the well-informed, deep-pocket bidder participated, her winning bid would likely exceed the value of the license. Understanding this, the first bidder may choose not to compete in auctions against such well-informed, deep-pocket bidders. The known participation of deep-pocket bidders, thus, tends to reduce competition in the auction, reducing prices actually paid. Therefore, the Commission should insist that the identities of the bidders be kept secret, to promote more effective competition.

Finally, several firms, including Pacific Bell, do not consider collusion a problem with oral bidding. While I agree that explicit collusion is very unlikely, it is nonetheless possible that revealing the identities of the bidders will facilitate implicit collusion.

IV. Disadvantages of a Separate National License

Many of the comments reflect a preference against the Commission's proposal for a national license auction on the 30 MHz licenses. In particular, American Personal Communications, Cellular Communications, Pacific Bell, BellSouth, McCaw, Paging Network, GTE, Sprint, Southwestern Bell, Comcast, Telelocator, AT&T, and several representatives of small firms oppose combination bidding for a national license. This is not surprising. A national license favors a few bidders at the expense of others and at the expense of the national interest, for it creates a distinct likelihood of a national license selling even when the MTAs are worth more individually than as a national license. Professor Weber, representing TDS, is particularly eloquent on this point.

Proponents of a national license, e.g., CTIA, MCI, and Bell Atlantic, do not offer powerful arguments in favor of such a separate auction. CTIA's own expert, Professor Mark Isaac, argues for the utility of full combinatorial bidding in his report. That is, his argument does not favor a national license, but rather favors full combinatorial bidding. It is illogical to conclude from this argument that a national license is desirable in the absence of other combinations being offered.

CTIA's argument that the bid price for the national license creates an "implicit reserve price" is false. While it may be true that if each firm bids at least the pro-rated value of the bid on the national license,⁶ then licenses will be sold individually, there is nothing in CTIA's proposal to induce bidders to bid that high. Indeed, one expects that the per person value of PCS licenses varies from area to area, with urban areas likely producing higher per person values. Therefore, bidders should not expect that licenses from low density areas will sell for prices proportional to high density areas. As a

⁶ The pro-rated value for an MTA is calculated by taking that national bid, dividing by the total population to find the price per person, and multiplying that figure by the number of people in the MTA.

consequence, the implicit reserve price of CTIA's proposal is unlikely to become even a focal point in the bidding, much less an inducement for a firm to raise its bid to prevent the license from selling nationally, when it can reasonably hope to "free ride" on later bidders.

MCI's proposal, which advocates a second-price or Vickrey auction on the national license, actually *exacerbates* the free-rider problem relative to the Commission's proposal. Since oral auctions tend to produce the second highest expected valuation as an equilibrium price, and Vickrey auctions tend to produce the highest expected valuation as a winning bid, the MCI proposal is tantamount to comparing the *highest* expected valuation on the national auction to the *second-highest* expected valuation on the individual licenses, insuring that a national license not only sells in circumstances where it is valued significantly less than the licenses are valued individually, but sells at a lower price as well.

MCI's proposal does not support the national interest in either efficiency or raising revenue, but effectively offers a subsidy for a national license even greater than the subsidy inherent in the Commission's proposal. MCI's proposal does not merit serious consideration, for it amounts to a proposal to subsidize a nationwide bidder at the taxpayers' and PCS consumers' expense. The likely outcome, were MCI's proposal adopted, is a very high bid for a national license, but a very low price actually paid.

Bell Atlantic's experts, Professors Bulow and Nalebuff, discuss a national license in Appendix B of their report, pp. 25-31. In their discussion they make two errors. First, they *assume* that a national license is the only aggregation that has any value. This is certainly not in accord with the facts. It is clear that aggregations of cellular licenses beyond the MTA level have been profitable and served consumers well. It is not at all clear that a national license is even efficient, much less the only efficient aggregation. Second, even if a national license were the only important aggregation, their proposal promotes inefficient aggregation, which they ignore. Indeed, they describe an example in

which it is assumed that bidders both know and choose to bid their value for the license. As is well established in the auction literature, bidders in an auction will act strategically to maximize profits, which involves bidding less than their maximum willingness to pay, contrary to the discussion in the report of Professors Bulow and Nalebuff.

V. Full Combinatorial versus Simultaneous Auctions

A significant number of the respondents indicate a preference for either simultaneous auctions or full combinatorial auctions. In particular, NYNEX, National Telecommunications and Information Administration ("NTIA"), Pacific Bell, Ameritech, and CTIA all advocate auctions that permit the bidders to express the interdependencies of the values of the licenses, either by simultaneous auctions, or by use of combinatorial auctions, where users can define subsets of the licenses on which to bid.

Full combinatorial auctions were recommended by several respondents, including CTIA,⁷ Ameritech, NYNEX, and NTIA. Combinatorial auctions have two fatal defects. First, as the Commission noted, combinatorial auctions have a "free-rider" problem. This problem is *not* solved by CTIA's proposal to announce the combinatorial bids prior to the individual auctions, because these bids are still likely to discourage participation in the individual auctions.⁸ The free-rider problem persists even when all combinations are

⁷ CTIA itself discusses only limited combinatorial auctions, effectively contradicting their expert, Professor Isaac, who argues for the benefits of full (i.e., all subsets) combinatorial auctions. As he states: "With the FCC plan, it is still all or nothing, and some of the disadvantages of non-combinatorial bidding remain." However, Professor Isaac also acknowledges the potential inefficiency of full combinatorial auctions. He then, somewhat illogically, considers that this means a separate auction for a national license is desirable.

⁸ CTIA's expert, Professor Isaac, would have the results of the national auction announced *before* the individual MTA bidding. In contrast, Bell Atlantic's experts would have the results of the national auction announced *after* the individual MTA bidding is complete. Neither of the proposals succeed in eliminating the free-rider problem. In particular,

allowed. Professor Isaac's proposal, which requires announcing the outcome of the national license prior to the oral auctions for the individual MTAs, does not solve the free-rider problem as alleged, although it reduces the free-rider problem under some circumstances. In particular, CTIA's proposal does not solve the problem that a bidder on a national license has a disincentive to participate in the individual MTA auctions. In the example provided in my prior report (see PacTel Auction Design Comments at 13-14), the use of CTIA's proposed auction continues to create inefficient aggregation.

The second problem with combination bids is the huge number of potential combinations.⁹ Because bidders can create their own combinations and bid on them, there may be thousands or even hundreds of thousands of auctions open simultaneously. This plethora of auctions will strain the capacity of competitors even to keep track of who is currently winning the auctions. The Commission should reject full combinatorial auctions because of the necessity of complex software and the immensely complex problem of bidding in these auctions, as well as the free-rider inefficiency they create. Full combinatorial auctions cannot be described as "transparent," i.e., easily understood by bidders. In particular, the admission of any combination a bidder desires permits the

bidders for a national license have a disincentive to participate in the individual MTA auctions, for participating in those auctions makes their national license less likely to succeed. If a bidder for a national license is the highest value holder of some, but not all MTAs, that bidder's incentive to stay out of the competition for individual MTAs creates an inefficiency that persists no matter when the results of the national competition are announced.

⁹ To make this point forcefully, consider the 492 BTAs. In a full combinatorial auction for just one of the channel blocks C-G, bidders could choose to bid on any possible subset of the BTAs. There are, in scientific notation, 1.28×10^{148} such subsets. The exact number is 12, 786, 062, 094, 304, 179, 739, 022, 253, 232, 809, 188, 346, 257, 992, 355, 721, 833, 919, 106, 906, 625, 522, 642, 205, 759, 980, 012, 773, 798, 148, 063, 113, 870, 651, 109, 873, 281, 527, 379, 754, 908, 382, 364, 816, 614, 564, 560, 895. This number is much larger than the number of electrons in the universe, estimated to be 10^{87} .

bidders to "game" the system, creating complicated aggregations for the sole purpose of blocking other bidders.¹⁰

In contrast to the claims of NTIA, full combinatorial auctions are not necessary when simultaneous auctions are used. Bidders can express a preference for a particular aggregation by bidding aggressively on the individual licenses of the aggregation. Thus, full combinatorial bidding creates needless complexity.

Finally, electronic auctions are one method of achieving simultaneous bidding, but not the only method. In my opinion, the Commission should use multiple rounds of sealed bids in lieu of electronic auctions because of the limited time to set up, test, and debug an electronic auction. Multiple rounds of sealed bids are easily understood by the bidders and avoid the use of complex computer software. In my view, there is insufficient time to deploy electronic auctions, while multiple rounds of sealed bids can be deployed in a matter of days.

VI. Summary and Conclusions

A consistent theme in the comments is that ascending bid auctions are preferable to one-time, sealed-bid auctions. This is correct. However, the best method to carry out ascending bid auctions for PCS license rights is with several rounds of sealed bids rather than oral bids. Simultaneous ascending bid auctions encourage efficient allocations of the spectrum, avoiding the biases inherent in sequential, oral auctions. Simultaneity permits the auctions to be completed more rapidly, yet still allow adequate time for

¹⁰ In fact, a clever bidding strategy in combinatorial auctions involves creating complicated geographical aggregations and bidding on those, in order to defeat bids on others' aggregations. That is, optimal bidding strategies may involve lots of strange aggregations, with the sole purpose of blocking others' aggregations. It may also be desirable to "muddy the water" to make one's opponents' lives difficult, by bidding on hundreds of thousands of aggregations.

deliberation and careful, informed bidding. The use of several rounds of sealed bids to carry out the simultaneous auctions avoids the necessity to develop, test, and debug new computer software and makes the auction easily understood by bidders.

The use of sequential oral auctions may cause license rights sold early to sell for too little. Until bidders observe the strategies of other bidders, they will choose to be conservative to avoid over-bidding, thus falling victim to the "winner's curse." This conservative bidding will become apparent as the sequential auctions proceed. In contrast, simultaneous auctions allow bidders to apply information from all of the auctions to each auction in which they bid, mitigating the "winner's curse," promoting more informed decisions, and resulting in a more efficient allocation of the PCS spectrum.

Oral auctions, by revealing the identities of the bidders, increase the likelihood of implicit collusion. In addition, revealing the participation of bidders with better information or deeper pockets may dampen competition, thus reducing the prices paid. In contrast, simultaneous rounds of sealed bids permit the Commission to conceal the identities of the bidders.

A separate auction for a national license promotes inefficient aggregation of the licenses, as was argued by many respondents. Offering a national license is both unnecessary and inefficient if the Commission auctions the licenses simultaneously. If a national license makes good business sense, it will be established with the simultaneous auction design described here.

Full combinatorial auctions suffer from three flaws. First, they encourage inefficient aggregations because of the "free-rider" problem identified by the Commission. Second, they are not readily understood by bidders, since bidders can employ extremely complex bidding strategies. Finally, they are computationally prohibitive, as bidders may choose to bid on hundreds of thousands of licenses.

In sum, the auction design that best achieves the Commission's goals consists of the use several rounds of sealed bids in which all geographic areas for given spectrum blocks are auctioned simultaneously.

CERTIFICATE OF SERVICE

I, Pamela J. Riley, do certify that on or before November 30, 1993 copies of the foregoing Reply Comments of PacTel Corporaton were either (1) sent via Federal Express (names marked with an asterick), (2) hand delivered, or (3) deposited in the U.S. Mail, first class, postage prepaid to the persons on the attached service list.


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