

Discussion of the Novel Auction Rules Should Not Be Limited to a Few Details

Comments on DA 00-2404,
“COMMENT SOUGHT
ON MODIFYING THE CALCULATION FOR DETERMINING
MINIMUM ACCEPTED BIDS AND CHANGING THE
PROVISIONS CONCERNING *LAST AND BEST BIDS*”
Report No. AUC-00-31-I (Auction No. 31)

by

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Public Notice DA 00-2404 seeking comments for possible improvements of the novel auction rules that the Commission plans to use for Auction No.31 is a step in the right direction. However, the Commission should open a discussion on the auction design proposed in the Public Notice DA 00-1486 as a whole. Limiting the scope of the discussion to a few details only, makes the process of improving the auction design, as well as the details in question, difficult if not impossible to conduct in a meaningful and productive way.¹

In our August 1, 2000², *Ex Parte* communication with the Commission, we explained why a serious consideration of the auction rules proposed in the Public Notice DA 00-1486 is necessary. We include this letter in the addendum.

We think that the modifications for which comments are sought are of limited importance and are not sufficient to impact the overall quality of the auction. This holds particularly for the proposed modification of the “last and best” bids option. As for the proposed modification of the calculation for determining minimum accepted bids, we see

¹ Since the multi-round format lets bidders consider alternative sequentially, the sudden shift to a previously unconsidered format that effectively allows unlimited use of alternatives in each round at the cost of enabling signaling needs explicit consideration. Furthermore, the discussion should probably go beyond the auction design due to the uncertainty winning bidders will face regarding the current incumbents of the spectrum. Without resolving this uncertainty, the current incumbents may well be unjustly enriched by their favorable position at the expense of the government and the taxpayers of the US regardless of the auction format used for the sale.

² On July 31, 2000, the postponement of Auction 31 was announced (Public Notice FCC 00-282) thereby allowing ample time for serious consideration of the proposed rules.

it as a clear improvement of the originally proposed calculation that will eliminate some of the potential pitfalls of the auction design. However, this proposed modification by itself cannot eliminate major shortcomings³ of the auction procedure described in the Public Notice DA 00-1486.

As for the particulars of the proposed modifications, without getting into the discussion whether or not these will improve the auction procedure we would like to present the following two comments to the Commission:

Bidding Units Vs. Bid Amounts

We are pleased that the Commission realized that allocating the “shortfall”⁴ by determining non-provisional bidder’s share according to some measure has to be an integral part of the minimum bid increment calculations. However, we are still of the opinion that bidding units are an artificial measure. In fact, the values of licenses/packages and the relationships among these values will be determined by the auction mechanism.⁵ This is the reason why we proposed use of the current prices as the best indicator, at any given point of time, of the relationships among the values of licenses/packages.

It is quite possible that, in an auction, the bidder valuations and bids on two licenses/packages A and B with equal amounts of bidding units will differ by orders of magnitude. It is also possible that both A and B are non-provisional winners and every shortfall set of one contains the other. Allocating equal burden of shortfall allocation to A and B is likely to make the cheaper license/package A unattractive for subsequent bidding and this will be further emphasized as the bids on other licenses/packages increase. Furthermore, the less likely are bids on A, the more likely it would be that B would be seen as a possible eligibility parking slot.⁶ The following example illustrates this concern:

Suppose that after many rounds of bidding there is a global bid of \$100, a bid of \$10 on one package of three regional licenses, and a bid of \$70 on the package of the other three regional licenses. Since the deficit of the regional packages is \$20 and they have half of the bidding units, the minimum increment on each would be \$10. For the first package, this is a 100% increase; for the second, it is 14%. Since it seems quite unlikely that there would suddenly be a 100% increase in the bid on the first package, a bid of \$80 on the second package is an ideal place to park eligibility.

Thus, we are concerned about the creation of unattractive licenses/packages and eligibility parking slots. On the other hand, the Commission has expressed concern about

³ See the *Ex Parte* communication in the addendum.

⁴ Note that this amount was first defined in combinatorial auctions context in Michael H. Rothkopf, Aleksandar Pekec and Ronald M. Harstad, "Computationally Manageable Combinational Auctions," *Management Science* **44**, pp. 1131-1147, 1998. See the definition and discussion of the minimal winning bid problem on p. 1137.

⁵ If the Commission really thought that the relationships between bidding units are equal to the relationships among the values of the licenses/packages to the future auction winners, it should have chosen a different auction mechanism, one that would exploit this fact (something closer to combinatorial auction of homogeneous items).

⁶ If there is no activity on A, increasing the bid on B by the minimum bid increment is not going to make B a provisional winner.

“... the risk that bidders might attempt to bid up the prices of licenses or packages they do not wish to acquire in order to increase the share of the shortfall allocated to those licenses or packages.” Such bidding would be risky for bidders, but to the extent it does occur, it would help the Commission by advancing the auction.

As for which measure “...better approximates the amount of a bid that could become part of the provisionally winning set”, we note that in either case more sophisticated calculations readily improve this approximation.⁷

Initial Bids for New Packages

There is no need for initial bids on new packages to be treated differently from other bids. In other words, the same calculation used for determining minimum bid increment should be used to determine initial bids on new packages. This auction involves only 12 licenses. Bidders may have reason to want to know the minimum initial bid on all combinations (i.e., individual licenses or packages) in order to understand the situation they and their competitors face. Finding the minimum initial bid on a combination requires solving an integer programming problem. At any point, it would be difficult, but probably possible, to calculate the initial bid for all possible $2^{12} - 1 = 4,095$ combinations.⁸ (However, it would be quite awkward to do so a few combinations at a time. It is likely that serious bidders will want the auctioneer to provide the software/code for this calculation or at the very least a fully detailed description of it.)

This is the Commission’s first combinatorial auction. One of the concerns that we expressed in our earlier comments was that the Commission should select a design for it that would scale gracefully to larger auctions.⁹ This design does not meet that criterion. For example, if there were 24 licenses, there would be $2^{24} - 1 = 16,777,215$ possible biddable combinations, and calculation of initial bids on all of them would most likely not be feasible. Having a simple and transparent winner determination algorithm (which would be the case if package bids were restricted as described in the Public Notice DA 00-1075) has its value.

We are under impression that the Commission proposed special treatment for the initial bid calculation of new packages in order to avoid described computational difficulties. As we have warned before,¹⁰ underestimating computational complexity and combinatorial issues in design of a combinatorial auction is risky.

Conclusion

We have pointed out that there are problems in the details that the Commission has asked for comments on. For example, the proposed calculation of the initial bid for

⁷ See Footnote 19 in the Appendix of *Making the FCC’s First Combinatorial Auction Work Well*, Comment on DA 00-1075, Comment Sought on Modifying the Simultaneous Multiple Round Auction Design to Allow Combinatorial (Package) Bidding” Report No. AUC-00-31-G (Auction No. 31), Aleksandar Pecek and Michael H. Rothkopf (June 7, 2000) (“Pecek and Rothkopf 6/7/2000 Comments”)

⁸ In their June 20, 2000 *Ex Parte* communication, de Vries and Vohra report that in their experiments such problems took 10 seconds on average to solve. If the Commission manages to speed this up by a factor of ten by having faster machines, optimized programs, and by exploring the possibility that the solution to a single integer program could be used to calculate minimum bid increments for several combinations as well as the fact that for a given package of k licenses the integer programming problem that has to be solved involves only 12-k licenses, more than one hour would be needed to perform all these computations.

⁹ See Section 3 of Pecek and Rothkopf 6/7/2000 Comments.

¹⁰ See Section 14 of Pecek and Rothkopf 6/7/2000 Comments.

new packages gives only a vague approximation of the bid amount that would ensure competitiveness. For another example, it is not hard to construct scenarios where a bidder could introduce a bid on a new package in order to park eligibility (and at the same time increase the computational time of the winner determination and minimum bid increase calculations for the auctioneer). However, we are concerned that discussing the inefficiencies of these details is insufficient since the FCC continues to avoid discussion of the core issue – the overall quality of the auction mechanism that it has proposed.

*Durham, NC and Piscataway, NJ
November 15, 2000*

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***Ex Parte* Comments on Auction No. 31: Now There is Time for Serious Consideration of the Novel Auction Rules**

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We are pleased that the FCC continues to plan to hold a combinatorial auction, and that it has now delayed the start of that auction¹ long enough to follow an appropriate process for the determination of the auction rules. We were distressed that the rules for the auction promulgated by the FCC on July 3, 2000 were largely based upon a completely new proposal posted on the afternoon of the last day of the period allowed for reply comments. Hence, this proposal was not subjected to the kind of review that the importance of the topic warrants or that previous auction rules have enjoyed. Indeed, many of the rules were not clearly spelled out even at the time they were announced. Now that the auction has been postponed for six months, there is time for review and thoughtful consideration of the rules. We recommend that the FCC reopen the proposed rules for comments.

It is critical that the FCC get right the details of the rules of its first combinatorial auction. There are valuable rights and large amounts of money at stake, and the situation is complex. If the rules are not appropriate, the allocation of the spectrum, appropriate government revenue, and the reputation of combinatorial auctions may all suffer.

The rules announced on July 3, 2000 are so novel that there is a risk of serious error from aspects that have not been considered or fully thought out. In addition, we have some specific concerns and questions about these rules. In our opinion, (a) the mutual exclusivity of bids placed by the same bidder in different rounds, and (b) the rule for determining minimum bid increment, are the problematic cornerstones of the proposed auction model. We are concerned that the negative aspects of the auction design built around these cornerstones may outweigh potential benefits and believe that any such benefits can be achieved by alternative rules that do not carry a heavy load of potential inefficiencies. In particular, we are concerned that the auction according to July 3 rules:

¹ Public Notice 00-282.

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- Fares unfavorably when compared to the non-combinatorial auction format used by the Commission. In other words, if no bidder in the auction submitted a package bid, would the Commission regret using the July 3 auction rather than the old auction?
- Does not easily generalize to auctions with (slightly) larger number of licenses due to complexity of the winner determination problem.
- Is highly nontransparent (e.g., the provisional winner determination algorithm).
- Allows for acceptance of noncompetitive bids and allows bidders to abandon bids too easily. We fear that this will facilitate insincere bidding and undesirable signaling between bidders. This could undermine the fairness and effectiveness of the auction. Furthermore, the pace of the auction could be far from appropriate. While some improvements of the proposed minimum bid increment are possible², the bidder-specific minimum bid increment (rather than the increment based on the current high bid) seems to be unavoidable as long as one insists on the mutual exclusivity of the bids placed by the same bidder in different rounds.
- Does not properly contemplate the high probability of ties³ and provides insufficient mechanisms for resolving them. The randomization process announced by the FCC for the treatment of tie bids will not work fairly in the way the FCC envisions⁴. Furthermore, the “best and final offer” approach to avoiding final ties is inferior to mechanisms proposed in the comments on the NOPR and has not been subject to review and comments.
- Requires the Commission to have state of the art expertise in underlying combinatorics, combinatorial optimization, and computational complexity that it appears to lack. The claims made in the second paragraph on page 25 of DA 00-1486, suggest that the Commission lacks sufficient understanding of the combinatorial and computational issues that come into play with combinatorial bidding.⁵ Similarly, the proposed randomization process for the treatment of tie bids indicates that the Commission does not have full understanding of the underlying algorithmic issues.⁶

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August 1, 2000*

² For example, using measure more appropriately related to economic forces as expressed by the bids (e.g., the measure we proposed in our comments) than the minimum \$/bidding unit of provisionally winning bids that is based on an artificial quantity (bidding unit). Furthermore, competitiveness and overcoming the threshold problem is more likely to be achieved by using some sort of an average (e.g. mean), rather than the minimum. Also the choice of the number of recent rounds under consideration seems to be arbitrary.

³ The probability of ties is considerably increased because of the package bidding in conjunction with click-box bidding.

⁴ While randomization could resolve ties in the case of identical bids on identical licenses/packages, this approach is bound for failure in more complicated situations. Randomizing the input of an algorithm for determining a (provisionally) winning collection of licenses/packages does not necessarily guarantee a random choice of an optimal solution from the set of all optimal solutions.

⁵ What reasons lead the Commission to determine that considering all bids is beyond their computational limit while the announced method where only last two active rounds of each bidder plus provisional winners are considered is not? Also, the claim about permitting unrestricted “or” bids being computationally complicated is false.

⁶ See footnote 4.

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