

# On Setting Minimum Bids and Calculating Minimum Bid Increments

Reply Comment on DA 02-260,  
“COMMENT SOUGHT ON ADDING TO AUCTION  
INVENTORY AND FURTHER MODIFYING PACKAGE  
BIDDING PROCEDURES”

by

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## 1. Minimum Bids

In its request for comments, the Commission asked for advice on how it should compute minimum acceptable bids, i.e. reserve prices. Most of the advice that the Commission is receiving is coming from those who stand to benefit from sales at low prices. The Commission, however, has a legal responsibility to collect for the US government a reasonable portion of the value of the licenses it sells. Doing so is not only good policy, but in this post-Enron-collapse era also good for the Commission’s reputation. Reserve prices are a key means of assuring that the Commission does collect a reasonable proportion of the value of the licenses it sells, and it should use them effectively.

First of all, the Commission asked if it should have reservation prices on individual licenses or on total revenue from the sale. We believe that the correct answer to this question is BOTH. In other words, we believe and recommend that the Commission not sell individual licenses or any collection of licenses if the bids on them are insufficient.

Here is our reasoning. It would be ideal if the Commission could set reservation prices at or marginally below market values, but the Commission does not know these values precisely, and the history of government agencies setting minimum bid levels is that they are often set well below going prices.<sup>1</sup> Hence, it is likely that the Commission’s reservation prices will be substantially below market prices. In this context, if the

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<sup>1</sup> For example, one of us observed some years ago that the US Forest Service, operating under a Congressional directive not to sell timber rights for less than fair market value, routinely calculated “fair market values” for use as minimum bids that averaged about 25% of what the timber rights sold for.

Commission sets a reservation price only on the total revenue, then a few licenses selling for full value due to competition (and cleared incumbents) could well drive up the price for the total sale to a level that would meet a collective reservation price even though most individual license are selling for next to nothing. This is bad policy, and in addition, it will look bad. Thus, the Commission needs to have and enforce a reservation price on each individual license, and at least minimally on all sets of licenses. If individual reserve prices are set, then, at a very minimum, the reserve price for any set should be set at the sum of reserve prices for all individual licenses in that set.<sup>2</sup>

On the other hand, setting reservation prices on individual licenses and enforcing the sum of the individual limits on sets of licenses is not sufficient. The whole reason for holding a simultaneous auction, especially one with combinatorial bids, is that the value of combinations of licenses is greater than the sum of the values of the individual licenses in the combinations. In other words, the synergy between licenses is valuable. The US government is entitled to receive, and the Commission is required by law to obtain for it, a reasonable proportion of this synergy as well as of the stand-alone values of the licenses. This strongly argues for a reservation price on the combination of all licenses (and possibly for ones on some other smaller combinations for which synergetic values are apparent) that is greater than the sum of the reservation prices on individual licenses. We fully realize that if the Commission fails to arrange properly for the clearance of incumbents from some licenses, the combination of this failure and such a global reservation price could prevent the sale of other individual licenses with serious bids. However, we hope that the Commission will properly protect the US Government's interests by proper arrangements for the clearance of incumbents from all of the spectrum it chooses to sell. Failure to do so will not only allow the incumbents to (unjustly) capture much of the economic rent from the spectrum they are using, but also much of the value of the synergy between that spectrum and the spectrum covered by other, properly cleared licenses the Commission does sell.

The Commission also asked for and received<sup>3</sup> advice on how to value the licenses it is selling for the purpose of setting minimum bids. We would like to comment on this issue and the advice the Commission received.

First of all, we firmly believe that the proper basis for the valuation is the value of the license with the spectrum cleared of incumbents less the cost of that clearance. To be perfectly clear, by the cost of clearance we mean the cost of relocating incumbents to other spectrum or compensating them for their losses for the right to use the spectrum they are surrendering. (We do NOT mean the amount that the incumbents could receive if they are allowed to prevent a new licensee from operating until they are paid.) This is the value of the license the Commission is selling and the value that the law requires it to obtain a reasonable portion of.

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<sup>2</sup> If reserve prices on individual licenses but not on packages were enforced, a bidder could use a package bid to win a set of licenses at a price below the sum of the reserve prices on the licenses in the set. Surely the Commission does not intend that. Note that a reserve price on the total revenue from the sale of all licenses will not solve that problem. For example, suppose that a reserve price is set at \$10 for each individual license, but not for some set of ten licenses S. Then, a \$1 package bid on S, in presence of a high enough collection of bids on licenses that are not in S, could win even though it is only 1% of the sum of the individual reserve prices for the ten licenses in S.

<sup>3</sup> Comments of Spectrum Exchange Group, LLC and Allen & Company Incorporated, filed on February 19, 2002.

Second, there has been some comment on whether the Congressional figure of \$2.6 billion dollars is the correct number for the total reasonable portion of the value.<sup>4</sup> We do not think that the Commission needs to be rigidly bound by that figure. However, it does apparently represent Congress' understanding of the situation, and we do believe that if the Commission deviates from that figure, it needs a careful and credible economic analysis to justify that deviation. If the Commission does not believe it can make such an analysis or if it does not believe it has done so, it should stick with the Congressional estimate.

Third, and related to the comment on the Congressional estimate, there has been some comment pointing out to the Commission that the value of wireless stocks has fallen and that this may mean that the value of the licenses has fallen.<sup>5</sup> The makers of this comment urge the Commission to set low reserve prices and rely solely on the market to determine the value. The Commission should not accept this flawed line of thought. Market values fluctuate, sometimes widely. Recovering a fair portion of the value of the licenses requires that the Commission set reasonable reserve prices even if those prices result in some licenses not being sold immediately. Except for some bankrupts who are given no choice, no business wants to or has to sell its assets at depressed prices. Private sellers normally set serious reserve prices in auctions or negotiations, knowing that if the current price is too low they can expect to get a better price another day. If the Commission is to be at all businesslike in protecting the long-term interests of the US government, it must behave the same way. Stock prices fluctuate for many reasons. Some of these reasons have nothing to do with the long-term value of the licenses. However, to the extent that the data on the fall of the stock prices of wireless companies represent temporary business conditions or result in temporary difficulties for wireless companies in obtaining financing, they are an argument FOR aggressive reserve prices, not against them.

## 2. Technicalities of the Minimum Acceptable Bid Computation

As we have already discussed in our filing,<sup>6</sup> the method of computing minimum bid increments is of marginal importance, if any, given other problems surrounding Auction No. 31 as well as the proposed package bidding design as a whole. Still, in order to set the record straight regarding the validity of some claims that were made in context of recommending one of the two modification options that the Commission has proposed, we want to reply briefly.

One comment<sup>7</sup> argued for Option 2 stating *“In general, we oppose increases in the complexity of the auction, such as those involved in Option 1, unless there is a clear basis for concluding that they entail a significant improvement over the simpler option. In this case, no basis for that conclusion has been offered.”* In fact, it is exactly overwhelming complexity of the current procedures,<sup>8</sup> that was experienced in the

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<sup>4</sup> *Ibid.*

<sup>5</sup> *Ibid.*

<sup>6</sup> “Thorough Analysis of Package Bidding Procedures is Still Needed”, filed on February 19, 2002.

<sup>7</sup> See footnote 3.

<sup>8</sup> Note that Option 2 was only a modest proposal of changing the current method for minimum bid increment calculations in the case of **newly created packages only**.

Commission's own experiments<sup>9</sup> and acknowledged by many conference participants,<sup>10</sup> which makes the minimum bid increment rule modified according to Option 2 considerably more complex to handle than the rule proposed in Option 1. In short, unlike Option 2, which would require solving multiple NP-complete problems (that could be solved by brute force at the expense of considerable computation time), Option 1 offers a significant improvement since it requires solving only well understood and computationally tractable problems (i.e., linear programming problems). Thus, for practical purposes, the minimum bid increment calculation under Option 1 is considerably simpler.<sup>11</sup>

It was further argued<sup>12</sup> that "*Option 1 sets minimum bids in ways that are less stable than Option 2 and employs heuristics whose performance is unproven.*" In our comment last week, we voiced our concerns about use of shadow prices. However, it should be noted that the current procedure (modified according to Option 2) is also a source of concern. It is nothing more than a heuristic with unproven performance.<sup>13</sup> Further, while we are not sure what is meant by "stable", we note that the current rules can also yield somewhat counterintuitive minimum bid increments (See Appendix).

Finally, a claim has also been made that "proxy bidding" could mitigate some of the problems implementing combinatorial auctions.<sup>14</sup> Theoretical evidence for such claim is unknown to us.<sup>15</sup> However, the commission ought to consider offering proxy bidding – after all, many on-line auction sites that implement much simpler auction procedures have offered proxy bidding AS AN OPTION for almost a decade now. Such an OPTION would likely be helpful in enticing participation of bidders who don't have resources to strategize from round to round of an auction. This is not particularly important in the context of Auction No. 31, but ought to be considered if package bidding (hopefully not in the currently proposed format) is implemented in some auctions offering licenses of interest to small business. In particular, the bidders should have an option to submit a maximum bid amount, and have a proxy-bidding agent bid for them by making minimum bid increases as long as the new bid does not exceed their maximum bid amount.

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<sup>9</sup> As reported by Karla Hoffman at the 2<sup>nd</sup> Combinatorial Bidding Conference. See p.21 of the presentation "Issues in Scaling Up the 700 MHz Auction Design", currently available at [http://wireless.fcc.gov/auctions/conferences/combin2001/papers/Wye\\_river\\_DAC.pdf](http://wireless.fcc.gov/auctions/conferences/combin2001/papers/Wye_river_DAC.pdf).

<sup>10</sup> For example, see, "Comments on the Second Wye River Package Bidding Conference" by P. Milgrom and L. Ausubel, available at <http://wireless.fcc.gov/auctions/conferences/combin2001/papers/combin2001-comments.pdf>. Interestingly, this note also argues in support of using shadow prices when calculating minimum bid increments.

<sup>11</sup> However, Option 2 might be simpler when it comes to its description (i.e., it might require fewer characters when formulated in print), but that is not the important measure of simplicity.

<sup>12</sup> See footnote 7.

<sup>13</sup> See "Discussion of the Novel Auction Rules Should Not Be Limited to a Few Details", that we filed on November 15, 2000 and Footnote 19 in "Making the FCC's First Combinatorial Auction Work Well", that we filed on June 7, 2000.

<sup>14</sup> See footnote 7 and footnote 10.

<sup>15</sup> In view of the computational intractability of winner determination, one has to be skeptical about such claims. It is likely, whatever the proposed medicine, that this inherent complexity would just manifest in a different way. In fact, there are several proxy-bidding models proposed in the artificial intelligence community (for example, *iBundle* combinatorial auction procedure developed by Parkes and Ungar). Typically, these proposals avoid the issue of computational complexity of implementation, by simply assuming that the winner determination problem is somehow solved externally.

MANDATORY proxy bidding (provided that the limit in the number of proxy bids on any given license or a combination is imposed) is an intriguing idea as it would effectively limit the number of rounds in which a bidder could submit bids, thereby potentially defining a procedure that falls somewhere between a single-round auction and an ascending auction. However, with such rule in place, the rounds of the auction would effectively amount to the number of instances in which any of bidders changes its proxy bid. Thus, the issue here is not one of proxy-bidding, but of imposing a limit on the number of times a bidder can submit a bid for a given license/combination. An extreme case would be a SINGLE MANDATORY round of proxy bidding.<sup>16</sup> This could turn the auction into a combinatorial version of a Vickrey auction and would require particularly careful consideration since Vickrey auctions are known to have serious practical drawbacks.<sup>17</sup> These known drawbacks would be particularly relevant if winning bidders had to negotiate with other parties (such as uncleared incumbents!) after receiving the licenses.

Clearly, if MANDATORY proxy bidding (or any other rule that would limit the number of rounds a bidder can submit their bids in) is of interest to the Commission, a serious analysis and discussion of it would be beneficial.

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<sup>16</sup> Note that in the absence of effective activity rules bidders in a multi-round auction with mandatory proxy bidding would have incentives to wait until the last round. This would convert the multi-round auction into a single-round auction.

<sup>17</sup> See Michael H. Rothkopf, Thomas J. Teisberg and Edward P. Kahn, "Why Are Vickrey Auctions Rare?" *Journal of Political Economy* **98**, pp. 94-109, 1990.

## Appendix.

The purpose of this appendix is to give an example that shows that the current rules for calculating minimum bids, whether or not modified by Option 2, can lead to strange changes in minimum bids.

Suppose that there are six licenses for sale A, B, C, D, E, F (e.g., one can think of those as regional combinations in Auction 31), each having exactly the same measure in bidding units. Suppose that the following bids are in the system (each from a different bidder and no other bids are in the system so that we avoid discussion of mutual exclusiveness across rounds), none of which is a newly-created package:

$$b(AB)=4, b(CDE)=6, b(F)=1,$$

$$b(FE)=4, b(DCB)=6, b(A)=1,$$

$$b(AF)=4, b(BC)=5, b(DE)=5.$$

Note that the revenue-maximizing collection is  $(AF+BC+DE)$  and has value 14. Also note that things look symmetric for the bidder who submitted bid on CDE and the bidder who submitted bid on DCB. Their “shortfalls” are 3 and their minimum bid increment according to current rules (with Option 2) is 1.5 (since they define exactly half of the total measure).

Now suppose that there is also a bid  $b(E)=1.5$ . Should the introduction of a new bid increase anybody's bid increment if max-revenue has not changed and, if so, should the bidder whose “shortfall” decreases have its bid increment increased? (Note that nothing changes for the CDE bidder and that the “shortfall” of the DCB bidder decreases to 2.5 since the revenue of  $AF+E+DCB=11.5$ . However, AF is a provisional winner, so the new increment for DCB is  $3/4$  of 2.5, which is  $1.875 > 1.5$ ; also note that the bid on E is not a provisional winner). Introducing  $b(E)=1.5$ , didn't introduce new provisional winners. It did reduce the “shortfall” for bidder on DCB, but this bidder is somehow penalized by an increase in its minimum bid increment (which is now larger than the minimum bid increment of the bidder on CDE). Or to look at things from a different angle, suppose that all bids were in the system initially (including  $b(E)=1.5$ ). Should the minimum bid increment decrease for DCB when  $b(E)=1.5$  is removed from the system, say due to mutual exclusiveness clause (given that E is not a provisional winner and that this removal will increase the DCB bidder's “shortfall”)?