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Comments:

Evan:

Some recommendations on controlling the pace of the MTA broadband auction follow. They are identical to my earlier email (except I fixed an addition error), which I sent to you, John McMillan, Preston McAfee, Paul Milgrom, Barry Nalebuff, and Bob Wilson. I will try to give you more detailed suggestions on the bid increment plan by Tuesday.

I will have MCI file these comments or I will file them on my own if MCI does not wish to file them.

Sincerely yours,

*Peter Cramton*

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*[Signature]*

## **Controlling the Pace of the MTA Broadband Auction**

**Peter Cramton, 8 Nov 1994**

The experience in the regional narrowband auction clearly shows that the number of rounds needed to reach closure can increase dramatically as the number of licenses and license types increases. In the nationwide auction 10 licenses were auctioned and there were 3 license types. In the regional auction there were 30 licenses and 20 license types (a 50/50 and a 50/12.5 in each of 5 regions for non-DE and DE bidders). The nationwide auction took 47 rounds to complete; the regional auction took 104 rounds. This is perhaps surprising given that the amount of uncertainty in the regional auction was much less, because of the information revealed in the nationwide auction. Indeed, most of the regional licenses were sold as nationwide aggregations (four of the six frequency blocks), so the nationwide prices were quite relevant. Moreover, the auction began with dramatic jump bids -- an initial bid of \$80 million for a nationwide aggregation, exactly equal to the final price in the nationwide auction. Some observers predicted that the auction would close in its first day. However, progress of the auction after the first few days was remarkably slow. From round 19 to round 104, only a single bidder dropped out of the bidding. Bids at or slightly above the minimum bid increment were common.

In what follows, I make several recommendations on how the FCC should control the pace of the auctions using three instruments: (1) activity rules, (2) minimum bid increments, and (3) the number of rounds per day. It is important that the FCC use all three instruments in combination and that there use be tied to a measure of bid activity. The measure that I propose for bid activity is the excess demand for licenses. Bid activity should be measured as the number of new bids, where each bid is weighted by the size of the license in MHz-pop relative to the total MHz-pop being offered. Hence, a bid activity of 1 means that the sum of the MHz-pops of the new bids is equal to the total quantity of spectrum being offered in MHz-pops. By auction close, bid activity (excess demand) falls to 0.

### **1 Activity Rules**

The activity rule proposed by Milgrom and Wilson is basically sound, with required levels of activity of 1/3 in stage 1, 2/3 in stage 2, and 90% in stage 3. Allowing 90% in stage 3, rather than 100%, is important, so that bidders are able to switch among licenses that are of similar size. A bidder bidding on Miami (5.4 million) should be able to switch to Tampa (5.7 million).

Bidder withdrawal creates a problem with the activity rule in stage 3. If the auction is near closure and someone withdraws from a large license, then no bidder would have the eligibility to bid on the license and the license would have to be sold at a subsequent auction. To prevent this problem, it makes sense to increase each bidder's eligibility by the size of the license with the withdrawn bid. However, a bidder's eligibility should not be increased above

its eligibility in the first round of stage 3. This prevents the reentry of bidders that dropped out early in the auction.

Given the complexity of tracking eligibility, it makes sense for the FCC to provide at the end of a round each bidder's eligibility in the next round. Such a table should be provided in both hard copy and over the internet (files e4\_nn.dbf and e4\_nn.txt where nn is the round number). Bidders can calculate eligibility based on the bidding history; nonetheless, the FCC should provide this information so that firms can check their own calculations.

## **2 Minimum Bid Increments**

The regional auction makes clear that the bid increment guidelines in the Fifth Report and Order are not realistic (5% in stage 1, 2% in stage 2, and 1% in stage 3). First, there is no reason to tie the bid increments to the activity rule stages. Activity rules and bid increments should be used in combination, but not in any fixed way. Both are needed, because they solve different problems. Activity rules prevent bidders from laying in the grass, bidding on only a few licenses when they have a demand for dozens at the current prices. Bid increments force prices to increase at a pace that assures timely closure. If the auctioneer suspects that progress is slow because bidders are laying in the grass, then a more stringent activity rule is needed. If the problem is that prices are going up slowly yet activity is high and no one is dropping out, then larger bid increments are needed. Often it will make sense for bid increments and activity requirements to move together, as both should be tied to bidding activity. However, the auctioneer will want to maintain the flexibility to move to a higher bid increment after entering stage 2 or stage 3, for example.

I continue to favor a linear rule for adjusting the bid increment with an upper and lower bound. Hence, the bid increment should be the greater of an absolute increment and a percentage increment, where the size of the increments are proportional to bidding activity. Reasonable bounds for the absolute increment would be an upper bound of \$0.10 per MHz-pop and a lower bound of \$0.02 per MHz-pop. Bounds for the percentage increment could be 25% to 5%. If the FCC allows more frequent rounds than 1 per day, increments of 12.5% to 2.5% (or even 10% to 2%) could be used. Going down to 1% increments is unrealistic in an auction with so many different licenses. The number of rounds to reach closure would number in the hundreds in this case.

I am now analyzing the regional data to identify a sensible parameter that determines the bid increment as a function of bidder activity. A linear rule based on bid activity is not too complex. Indeed, it is easier for the bidders to understand than other aspects of the rules, such as the activity rules and the use of waivers. I recommend using a linear rule and then let the auctioneer vary the parameters as needed.

### **3 Number of Rounds per Day**

The FCC should expect the MTA broadband auction to require even more rounds than the regional narrowband auction, since there are more licenses, more license types, more bidders, and more uncertainty. Hence, the current plan of one round per day is not realistic. The FCC should adopt a flexible plan, in which the number of rounds per day varies with the bidding activity. When bidding activity is high, the bidders will require more time to analyze their positions and develop strategies for the next round; when bidding activity is low (i.e., limited to a handful of licenses), then the FCC can safely conduct many rounds per day without fear of introducing inefficiencies.

I propose that the FCC have several "standard" daily schedules, that have 1, 2, 3, or 4 rounds per day. Then the auctioneer can switch among the standard schedules with a days notice. Ideally, the auctioneer will be able to announce on Friday the schedule for the next week and will be able to stick to the announced schedule. However, the auctioneer should maintain the flexibility to switch schedules by announcement. The announcement should be made available in hardcopy and over the internet (in a file a4\_nn.txt where nn is the round number).

Below are four standard schedules that I feel would be ideal from the bidders perspective. I only list the "end of bid submission" and "end of withdrawal period", since these are the critical times. The FCC should accept bids over a period of a few hours (or more). The withdrawal period should begin within 5 to 10 minutes after the end of the bid submission period, which is ample time to post the bids.

**a. One per Day Schedule**

1. 8:30 am end of bid submission; 9:00 am end of withdrawal

**b. Two per Day Schedule**

1. 8:30 am end of bid submission; 9:00 am end of withdrawal
2. 4:30 pm end of bid submission; 5:00 pm end of withdrawal

**c. Three per Day Schedule**

1. 8:30 am end of bid submission; 9:00 am end of withdrawal
2. 1:30 pm end of bid submission; 2:00 pm end of withdrawal
3. 6:30 pm end of bid submission; 7:00 pm end of withdrawal

**d. Four per Day Schedule**

1. 8:30 am end of bid submission; 9:00 am end of withdrawal
2. 12:30 pm end of bid submission; 1:00 pm end of withdrawal

3. 4:30 pm end of bid submission; 5:00 pm end of withdrawal
4. 8:30 pm end of bid submission; 9:00 pm end of withdrawal

Experience from the Nationwide and Regional Narrowband Auctions has demonstrated that the bidders need more time in the early rounds and less time in the later rounds. This is because much more information is revealed in the early rounds of bidding than later on. It is in the early rounds that large jump bids will be seen, with bidders expressing preferences for particular aggregations. Toward the end of the auction, most information has been revealed. What remains are a few contests to see which among a few firms will scale back its demand. Hence it makes sense to have longer bidding rounds early in the auction when bidding activity is high and shorter bidding rounds toward the end of the auction when bidding activity is low.

I propose the following schedule, which could be modified by the FCC based on bidding activity and behavior. Under this schedule, the bidders would have at least 5 hours to prepare bids after bids are posted. I think this is ample time, especially since the 3 per day schedule does not begin until round 14. By then the most major strategic plays will have been made.

#### Standard Schedule (Rounds Per Day)

|       | Week 1<br>Dec 5-9   | Week 2<br>Dec 12-16 | Week 3<br>Dec 19-21    | Week 4<br>Jan 4-6  | Week 5<br>Jan 9-13   |
|-------|---------------------|---------------------|------------------------|--------------------|----------------------|
| Mon   | 1                   | 2                   | 3                      | break              | 3                    |
| Tue   | 1                   | 2                   | 3                      | break              | 3                    |
| Wed   | 1                   | 2                   | 3                      | 3                  | 3                    |
| Thu   | 2                   | 3                   | break                  | 3                  | 3                    |
| Fri   | 2                   | 3                   | break                  | 3                  | 3                    |
| Total | 7                   | 19                  | 28                     | 37                 | 52                   |
|       | Week 6<br>Jan 16-20 | Week 7<br>Jan 23-27 | Week 8<br>Jan 30-Feb 3 | Week 9<br>Feb 6-10 | Week 10<br>Feb 13-17 |
| Mon   | 3                   | 3                   | 3                      | 3                  | 3                    |
| Tue   | 3                   | 3                   | 3                      | 3                  | 3                    |
| Wed   | 3                   | 3                   | 3                      | 3                  | 3                    |
| Thu   | 3                   | 3                   | 3                      | 3                  | 3                    |
| Fri   | 3                   | 3                   | 3                      | 3                  | 3                    |
| Total | 67                  | 82                  | 97                     | 112                | 127                  |

|              | <b>Week 11</b><br><b>Feb 20-24</b> | <b>Week 12</b><br><b>Feb 27-Mar 3</b> | <b>Week 13</b><br><b>Mar 6-10</b> | <b>Week 14</b><br><b>Mar 13-17</b> | <b>Week 15</b><br><b>Mar 20-23</b> |
|--------------|------------------------------------|---------------------------------------|-----------------------------------|------------------------------------|------------------------------------|
| Mon          | 3                                  | 3                                     | 3                                 | 3                                  | 3                                  |
| Tue          | 3                                  | 3                                     | 3                                 | 3                                  | 3                                  |
| Wed          | 3                                  | 3                                     | 3                                 | 3                                  | 3                                  |
| Thu          | 3                                  | 3                                     | 3                                 | 3                                  | 3                                  |
| Fri          | 3                                  | 3                                     | 3                                 | 3                                  | 3                                  |
| <b>Total</b> | <b>142</b>                         | <b>157</b>                            | <b>172</b>                        | <b>187</b>                         | <b>202</b>                         |

I believe that with the bid increment rule above about 150 rounds is a realistic estimate of the number of rounds needed to reach closure. Hence, the auction would conclude in early March. If the FCC felt that a more rapid closure was desirable or if smaller bid increments were desired, then the FCC could adopt an accelerated schedule that had four rounds per day. This would still give the bidders at least 4 hours to prepare bids after the round results are posted.

**Accelerated Schedule (Rounds Per Day)**

|              | <b>Week 1</b><br><b>Dec 5-9</b> | <b>Week 2</b><br><b>Dec 12-16</b> | <b>Week 3</b><br><b>Dec 19-21</b> | <b>Week 4</b><br><b>Jan 4-6</b> | <b>Week 5</b><br><b>Jan 9-13</b> |
|--------------|---------------------------------|-----------------------------------|-----------------------------------|---------------------------------|----------------------------------|
| Mon          | 1                               | 3                                 | 3                                 | break                           | 4                                |
| Tue          | 1                               | 3                                 | 3                                 | break                           | 4                                |
| Wed          | 2                               | 3                                 | 3                                 | 3                               | 4                                |
| Thu          | 2                               | 3                                 | break                             | 3                               | 4                                |
| Fri          | 2                               | 3                                 | break                             | 3                               | 4                                |
| <b>Total</b> | <b>8</b>                        | <b>23</b>                         | <b>32</b>                         | <b>41</b>                       | <b>61</b>                        |

|              | <b>Week 6</b><br><b>Jan 16-20</b> | <b>Week 7</b><br><b>Jan 23-27</b> | <b>Week 8</b><br><b>Jan 30-Feb 3</b> | <b>Week 9</b><br><b>Feb 6-10</b> | <b>Week 10</b><br><b>Feb 13-17</b> |
|--------------|-----------------------------------|-----------------------------------|--------------------------------------|----------------------------------|------------------------------------|
| Mon          | 4                                 | 4                                 | 4                                    | 4                                | 4                                  |
| Tue          | 4                                 | 4                                 | 4                                    | 4                                | 4                                  |
| Wed          | 4                                 | 4                                 | 4                                    | 4                                | 4                                  |
| Thu          | 4                                 | 4                                 | 4                                    | 4                                | 4                                  |
| Fri          | 4                                 | 4                                 | 4                                    | 4                                | 4                                  |
| <b>Total</b> | <b>81</b>                         | <b>101</b>                        | <b>121</b>                           | <b>141</b>                       | <b>161</b>                         |

|              | <b>Week 11</b><br><b>Feb 20-24</b> | <b>Week 12</b><br><b>Feb 27-Mar 3</b> | <b>Week 13</b><br><b>Mar 6-10</b> | <b>Week 14</b><br><b>Mar 13-17</b> | <b>Week 15</b><br><b>Mar 20-23</b> |
|--------------|------------------------------------|---------------------------------------|-----------------------------------|------------------------------------|------------------------------------|
| <b>Mon</b>   | 4                                  | 4                                     | 4                                 | 4                                  | 4                                  |
| <b>Tue</b>   | 4                                  | 4                                     | 4                                 | 4                                  | 4                                  |
| <b>Wed</b>   | 4                                  | 4                                     | 4                                 | 4                                  | 4                                  |
| <b>Thu</b>   | 4                                  | 4                                     | 4                                 | 4                                  | 4                                  |
| <b>Fri</b>   | 4                                  | 4                                     | 4                                 | 4                                  | 4                                  |
| <b>Total</b> | <b>181</b>                         | <b>201</b>                            | <b>221</b>                        | <b>241</b>                         | <b>261</b>                         |