Spectrum-Auction Design: A Case Study

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October 2013

Executive summary

In February 2012, Congress passed the *Middle Class Tax Relief and Job Creation Act of 2012 (Act)*. The *Act* allows the Federal Communications Commission (FCC) to buy back spectrum in the 600MHz band from broadcasters and then auction it. This spectrum is to be used for commercial wireless broadband.

The proceeds of the 600MHz auction in which the FCC sells the spectrum are intended to pay for the broadcast spectrum and for broadcaster-relocation expenses, to fund the buildout of the public safety network, and to raise money for the Treasury for debt reduction. Thus, maximizing auction proceeds is a specific and important objective for this auction.

Maximizing auction proceeds relies on the FCC's ability to set a revenue target that accurately predicts the maximum value of the spectrum to be auctioned. The challenges the FCC faces in doing this are highlighted by the experience of Auction 73, which teaches us that there is considerable risk that the FCC's revenue target will not match the spectrum's full market value. Increasing the complexity of the FCC's task, the 600MHz auction will simultaneously acquire spectrum from broadcasters in a reverse auction and sell it to wireless carriers in a forward auction, making the amount of spectrum available for sale unpredictable. Yet another layer of complexity would be added by the various proposals that have been made to limit AT&T and Verizon's participation in the auction.

The *Act* forbade the FCC to exclude any qualified bidders, but did allow it to apply spectrum aggregation rules. Traditionally, the FCC has allowed all would-be bidders[2] to participate in auctions. After the close of the auction, it has applied spectrum aggregation rules to the auction results, reviewing specific markets that trigger a concern about excessive holdings by a single carrier. Various parties have encouraged the FCC to combine the two steps into one in the 600MHz auction, by limiting participation in the auction by AT&T and Verizon. [3]

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[2] The FCC does apply some qualifications, such as financial viability.

[3] The exclusionary proposals take various forms, generally arguing that AT&T and Verizon should not be allowed to bid in markets in which they own more than a certain percentage of the spectrum below 1GHz. A frequently cited threshold is one third of the spectrum below 1GHz. In effect, such a condition could exclude them from bidding in most of the major markets. Verizon, for example, argues that a cap excluding it from acquiring spectrum in markets in which it owns a third of the spectrum below 1GHz pre-auction would prevent Verizon from bidding on 18 of the top 20 markets. T-Mobile, as we discuss below, would allow them to bid on a single 5x5 block even in

The proposals to exclude AT&T and Verizon have raised the concern that the auction will not maximize proceeds. On June 21st, T-Mobile filed a proposal that tries to address the risk that without AT&T and Verizon the auction proceeds will be reduced to the point that the FCC's revenue target—as yet unspecified--is not reached. T-Mobile's proposal (the proposal) would then bring in AT&T and Verizon as pinch-hitters long enough to reach the revenue target.

T-Mobile's premise for this proposal is that AT&T and Verizon would raise auction proceeds if allowed to bid. We accept T-Mobile's premise that an auction that includes AT&T and Verizon will raise greater funds than one that excludes them. Given the four national players' relative spectrum positions, with Sprint characterized by Deutsche Bank as a "spectrum powerhouse" that holds more spectrum suitable for LTE than all three of its national competitors combined, it is likely that T-Mobile will essentially be bidding against the FCC's revenue target if AT&T and Verizon are excluded. [4]

In that case, if the FCC accepts the proposal and sets a target that underestimates the full value of the spectrum, the auction proceeds will be less than the maximum possible. The parties that are allowed to bid will pay less than the full market value of the spectrum, and the discount they receive will be—literally--incalculable.

Commissioner Rosenworcel has said, in the context of the FCC's data-collection efforts, that "we cannot manage what we do not measure."[5] Auction design that excludes some potential bidders would make it impossible for the FCC to measure the value of the spectrum it auctions, the extent to which it reduces the Treasury's proceeds, and the discounts it provides to the included bidders.

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markets where they exceed that threshold, but Verizon's ex parte points out that amount is too small to justify incorporating a new band in handsets and cell sites. Ex parte letter from Tamara Preiss, Verizon in FCC Dockets 12-268 and 12-269, July 17, 2013.

[4] A Deutsche Bank Market Research Report by Brett Feldman dated July 11, 2013 titled "Sprint Nextel Corp. The new spectrum powerhouse" points out that Sprint has more bandwidth available for LTE than all of its national competitors combined. Deutsche Bank's analysis looks at raw spectrum, not at spectrum per subscriber. An Evercore Partners U.S. Equity Research report on Sprint Corp. by Jonathan Schildkraut dated September 8, 2013 shows that on a MHz per subscriber basis, Sprint is ahead of the pack in the top 100 markets with 3.6 MHz per million subscribers. T-Mobile follows with 1.66, AT&T with 1.24 and Verizon with 0.9 MHz per million subscriber (this includes the pending LEAP transaction for AT&T). A Macquarie Equities Research report dated July 29, 2013 by Kevin Smithen titled "Spectrum and network capacity vs. traffic demand for the Big 4 wireless carriers" makes a similar point. It notes that AT&T will have the most acute spectrum shortfall by mid-2015 and Verizon will also need more spectrum by mid-2015. In contrast, it notes that T-Mobile and Sprint will be in a strong spectrum and network capacity position once they complete their current network upgrades.

The relative spectrum positions of the carriers make it likely that AT&T and Verizon would place the highest value on the spectrum. If they are excluded, the key bidders are likely to be T-Mobile and Sprint and the auction's proceeds will depend on their bidding energetically against each other. But given Sprint's enormous spectrum advantage over its national competitors, its willingness to pay up for spectrum is likely to be limited. Thus, T-Mobile will essentially be bidding against the FCC's revenue target. If that target is below full market value, i.e. the value AT&T and Verizon would place on it, then auction proceeds will be below full market value.

[5] Commissioner Jessica Rosenworcel, "Statement re Modernizing the FCC Form 477 Data Program," June 27, 2013.

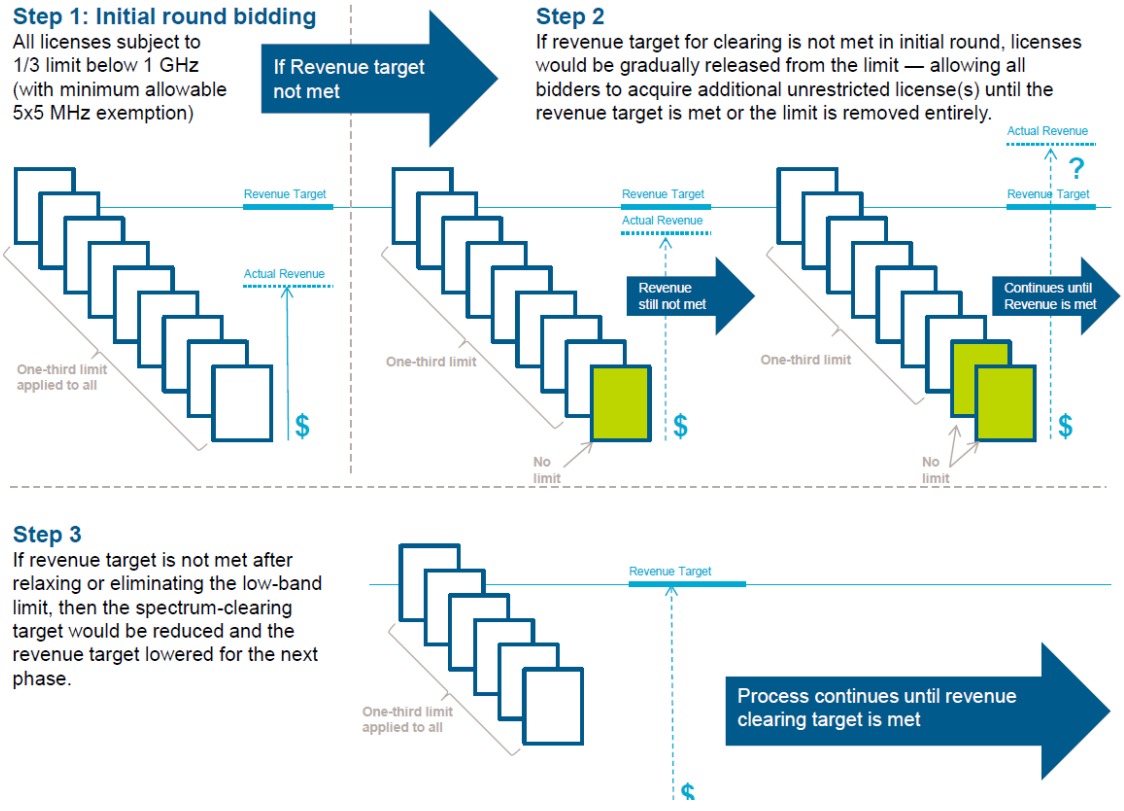
In contrast, an auction open to all willing bidders would establish the full market value of each block of spectrum. The FCC could then make its spectrum-aggregation decisions in a second step, as it has traditionally, with full knowledge of the financial implications of its decisions. That would enable it to optimize proceeds to the Treasury while limiting excessive spectrum-aggregation.

Discussion

The T-Mobile proposal:

The proposal seeks a cap on any carrier in any market of one third of all spectrum below 1GHz. However, it suggests that AT&T and Verizon be allowed to buy a single 5x5 block of paired 600 MHz spectrum even in markets where they exceed that cap. Beyond those exceptions, the proposal would exclude AT&T and Verizon from the auction, unless the auction fails to reach the FCC's revenue target.[6]

If the auction meets the FCC's revenue target without the help of AT&T and Verizon, the auction closes. If it fails to do so, one license is opened to bidding by AT&T and Verizon. If that increases auction revenue enough to meet FCC's target, the auction closes. If not, another license is opened up to AT&T and Verizon for bidding. This iterative process of opening up one license at a time continues till the FCC's revenue target is met. The graphic below, from the T-Mobile ex parte, illustrates the process:[7]



[6] Hogan Lovells on behalf of T-Mobile, ex parte notice in FCC WT dockets No. 12-268 and 12-269, June 21, 2013. This proposal is also described in T-Mobile's June 17th comments in WT docket No. 13-135 re the FCC's 17th Wireless Competition Report, pp. 14-21.

[7] Hogan Lovells for T-Mobile, June 21, 2013, attachment.

The proposal would only maximize auction proceeds if the revenue target that the FCC sets equals the full market value of the spectrum that is being auctioned. In other words, the success of the proposal hinges on the FCC's ability to value accurately the spectrum that is available for auction. Auction 73 provides a case study that indicates that the FCC, despite its enormous expertise in running auctions, is unlikely to predict the value of the spectrum accurately, in total or by individual block.

Auction 73—reserve price v. market value:

In Auction 73, the FCC set a reserve price on each block of spectrum and the sum of those reserve prices was, in effect, its revenue target. The FCC's revenue target in Auction 73 was $10 billion. In reality, that auction raised $19 billion, although neither T-Mobile nor Sprint participated in the auction, the D-block did not sell, and the financial environment was difficult. Even under tough circumstances, Auction 73 provided the Treasury $9 billion more than the FCC had anticipated.

Not only was the total revenue from the auction unexpectedly high, the distribution of the revenue by block was also radically different than the FCC had projected.[8]

Block	Licenses Offered	Provisionally Winning Bid (PWB) Total	Licenses with PWBs	Reserve Price	Winning Bids Total	Net Winning Bids Total	Licenses Won
A	176	$3,961,174,000	174	$1,807,380,000	$3,961,174,000	$3,875,663,800	174
B	734	$9,143,993,000	728	$1,374,426,000	$9,143,993,000	$9,068,382,850	728
C	12	$4,748,319,000	12	$4,637,854,000	$4,748,319,000	$4,746,691,000	12
D	1	$ 472,042,000	1	$1,330,000,000	$0	$0	0
E	176	$1,266,892,000	176	$903,690,000	$1,266,892,000	$1,266,844,500	176
Total	1,099	$19,592,420,000	1,091	$10,053,350,000	$19,120,378,000	$18,957,582,150	1,090

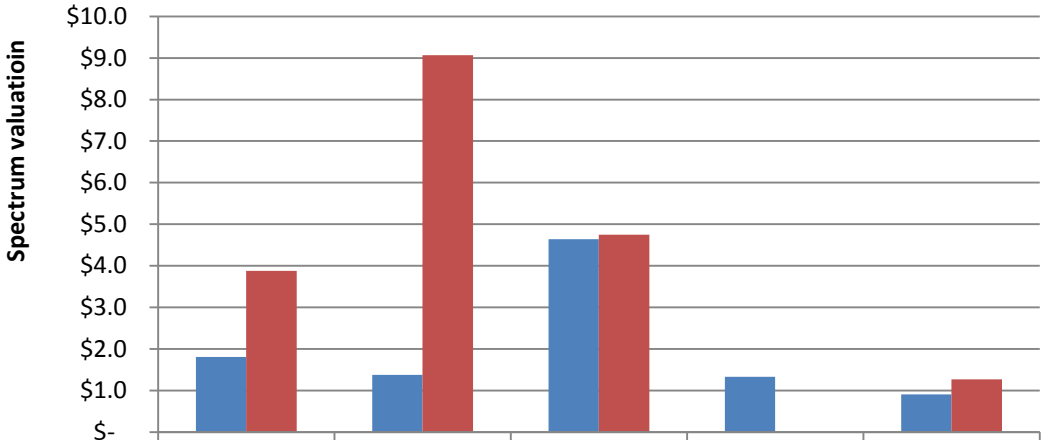
In Auction 73, proceeds for all blocks except the D-block were higher. The D-block did not sell, because the FCC's reserve price was not met. The A-block raised more than twice as much as expected, but the B-block nearly seven times as much.

[8] Federal Communications Commission, "Public Notice: Auction of 700 MHz Band Licenses Closes", docket DA No. 08-595, March 20, 2008, p. 2.

Figure 1

Auction 73 winning bids v. reserve prices

($ billions)



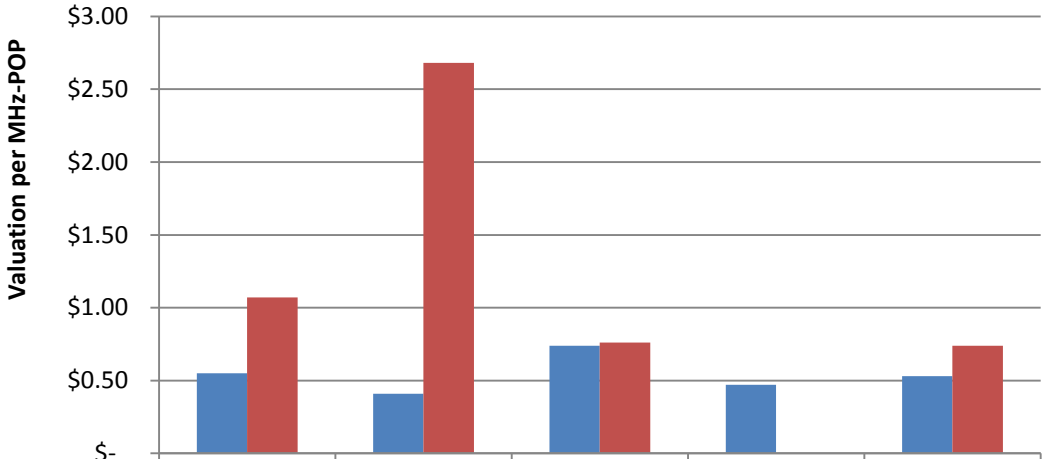
	A	B	C	D	E
reserve valuation	$1.8	$1.4	$4.6	$1.3	$0.9
net winning bids	$3.9	$9.1	$4.7	$-	$1.3

Source: FCC

The B-block which had the lowest reserve price per MHz-POP was sold for the highest valuation by far, bringing in $2.68 per MHz-POP rather than the expected $0.41 per MHz-POP. In fact, $7.7 billion of the auction's surplus above its $10 billion 'revenue target' came from this one block, which raised $9.1 billion instead of the expected $1.4 billion.

Figure 2

Auction 73 valuations per MHz-POP
winning bids v. reserve prices



	A	B	C	D	E
reserve valuation	$0.55	$0.41	$0.74	$0.47	$0.53
actual valuation	$1.07	$2.68	$0.76	$-	$0.74

Source: FCC

The FCC has tremendous expertise in running auctions, both internally and via outside experts, but it is clear from Auction 73 that it can nevertheless radically underestimate the value of the spectrum it is auctioning. Were the FCC to accept T-Mobile's proposed auction design for the 600 MHz auction, it would accept the likelihood that the auction would raise far less than the maximum amount the spectrum is worth. Applying the rules of the proposal to Auction 73 shows that the FCC would have raised far less revenue than it did, and that the shortfall would have been undetectible.

To reiterate, the premise of the proposal is that the 600MHz auction does not reach its revenue target, and then AT&T and Verizon would be allowed to bid on individual blocks, one at a time, until the target is met. Let us assume that Auction 73 initially excluded AT&T and Verizon but included all other bidders who chose to enter and qualified. Let us assume that each block provided the expected reserve price and only that price, except the D-block which did not sell.[9] That would have left a $1.3 billion deficit, i.e. the reserve price of the D-block.

Per the proposal, a block would then have been opened to AT&T and Verizon. Let us assume that the D-block was re-auctioned first since the FCC hoped to bring as much spectrum as possible into commercial

[9] One can also assume alternate scenarios that result in the need to allow AT&T and Verizon to enter, with some blocks bringing in more than the reserve and others less, so that the total is still below the revenue target. We choose this scenario as the illustration because it is the simplest and easiest to discuss.

use for broadband. But it again remained unsold (given the chance in the actual Auction 73, neither AT&T nor Verizon bought the D-block).[10]

Let us assume next that the FCC is also trying to maximize auction revenues while minimizing the number of blocks it opens to AT&T and Verizon. That is to say, it will open the blocks based on the valuation per MHz-POP that is implied in its reserve price, beginning with the FCC's highest valuation per MHz-POP.

As Figure 2 shows, the FCC in attempting to maximize proceeds would have re-opened the C-block, for which it had the highest valuation per MHz-POP. That block had an open-access condition which discouraged some potential bidders, including AT&T. It is likely that Verizon would have bid and, in the absence of counterbids, would again have won that block for the same price it paid in the actual Auction 73.[11] That would have reduced the $1.3 billion deficit by about $0.1 billion.

The FCC would have opened the A-block next to AT&T and Verizon, since that block had the next-highest valuation per MHz-POP. The A-block would have been rebid, not at the $1.8 billion reserve price, but at the $4.0 billion that the block actually raised in Auction 73. The $1.3 billion deficit would now have been filled. The FCC's revenue target having been met, Auction 73 would have closed with total proceeds of $11 billion.

Block A would have raised the re-bid $4 billion, B would have raised the reserve $1.4 billion, C the newly bid $4.7 billion, and E the reserve $0.9 billion. There would have been no reason to re-open bidding on the B-block which was so radically undervalued by the FCC, or E block which was undervalued to a lesser extent.

Instead of sending out a public notice saying that the auction was very successful and raised $9.0 billion more than anticipated, the FCC would have sent out a notice saying that it was a very successful auction that raised $1 billion more than anticipated. And no one would ever have known that the auction actually raised $8.1 billion less than the spectrum was worth in an open auction. Nor would anyone have even known that the auction could have raised $5.6 billion more had the FCC opened the B-block for bidding before the A-block.

In other words, the T-Mobile proposal requires the FCC to value not only the total spectrum available for sale perfectly, but each block. Given that the FCC cannot even know ahead of the simultaneous forward and reverse auction how much spectrum will be available for sale, that is an unrealistically tall order.

[10] The highest bid in Auction 73 for the D-block was $0.17 per MHz-POP, for a total of $472 million by Qualcomm. Even if we assume that the block is sold at that price in our example (because the revenue target is on the entire spectrum, not on individual blocks), there would be a deficit of $0.8 billion dollars below the 'revenue target', and the rest of the scenario would run as described above.

[11] We are assuming that Auction 73's conditions for the C and D blocks and the interference issues on the A block are unchanged in this re-run.

Consequences of adopting the T-Mobile proposal:

To maximize auction proceeds under the proposal, the FCC's revenue target would have to equal the full market value of the spectrum available for sale in the auction. Auction 73's results show that the FCC is likely to misestimate, a likelihood that increases with the complexity of the auction. The 600MHz auction, which involves simultaneous forward and reverse auctions, is far more complex than Auction 73, and thus more vulnerable to miscalculation.

If the FCC's revenue target is below full market value, then the auction design proposed by T-Mobile ensures that proceeds will fall short of full market value, the included bidders will receive a discount, and that discount will be literally incalculable:

- First, it makes it possible for the included bidders to aim for the 'revenue target' in order to close the auction without ever opening any block to higher bids by AT&T and Verizon.

- Second, if the auction fails to meet its overall target, blocks are opened individually till the target is met. Thus, the unopened blocks are still sold below their full market value and the included bidders' discounts on those blocks are locked in.

- Third, the full market value of some or all of the blocks is never revealed, thus unavoidably hiding the discount from full-market-value received by the included bidders.

Even if bidding between the included bidders in the 600MHz auction were to result in auction proceeds above the minimum reserve, i.e. above the 'revenue target,' the problems remain. The proceeds are still likely to be below full market value and the FCC, Congress and the public will still have no way of knowing what an auction open to all bidders would have raised.

Similarly, one can debate whether AT&T and Verizon would bid differently if they have only a few blocks open to them than they would if they have more opportunities in the auction. It is possible, in the hypothetical re-run of Auction 73, that AT&T might have bid on either the C-block or A-block in such a serially-run auction, although it did not do in the real auction 73. It is also possible that it would still have risked waiting for the B-block it actually wanted, and then never had the chance to bid on it. There is, again, no way to know without running an open auction.

That is really the lesson of Auction 73. The FCC, despite its expertise, greatly underestimated the value of the spectrum it was selling. But it compensated for that by having an open auction in which all willing and able bidders participated.[12] That ensured that the FCC did not limit the proceeds to its $10 billion undervalued revenue target. And because all blocks were open for auction at once, rather than one at a time, the FCC found out that the B-block had the highest market value. Whatever spectrum aggregation decisions the FCC made about Auction 73 were made with full knowledge of the financial implications of its actions.

[12] Frontline Wireless had hoped to bid on the D-block, but could not get funding at the last minute, after the FCC rules and reserve prices were locked in.

Conclusion:

The T-Mobile proposal, like all the exclusionary proposals, intertwines auction design and spectrum aggregation policy. That makes it inevitable that the true value of the spectrum, whether higher or lower than the proceeds of an exclusionary auction, will never be revealed. It makes it likely that the proceeds will be less than the maximum possible, as this proposal itself premises. It makes it likely that parties that are allowed to bid will pay less than the full market value of the spectrum. And it makes it inevitable that the discount they receive will not be public, because it will literally be incalculable.

The primary differences between having an open auction and then applying spectrum limits v. having an exclusionary auction is the price of the spectrum and the visibility of that price. If the FCC runs an auction open to all willing and able bidders, as it did in Auction 73, each block will be bid in the auction at its full market value. Congress and the FCC will know what the spectrum is worth and the Treasury will receive that full market value.

The FCC can then decide whether it wants to require divestitures, looking at each market individually. It can still prohibit spectrum aggregation in specific markets where it finds a threat to competition. But the revenue risk now would be borne by the carrier who has to divest spectrum, not by the Treasury. The Treasury will have locked in the full market value of the spectrum the FCC is able to recapture from broadcasters for auction.

The FCC has, in the past, provided bidding credits to designated entities and those credits were essentially discounts, so there is certainly a path for helping entities that may be unable to afford full price, as well as a precedent for raising less than the maximum possible proceeds. But those discounts were targeted, limited, and published.

What is the effect of T-Mobile's proposal? It makes it possible for the bidders who are included in the initial round to limit their bids to the FCC's revenue target rather than to the full market value of the spectrum. If that target is not reached, it still allows them to lock in the below-market-value prices on those blocks that are not re-opened to AT&T and Verizon. In other words, assuming as the proposal does in its premise, that AT&T and Verizon are likely to bid higher than others for spectrum,[13] a discount to the included bidders is both likely and unavoidably hidden.

[13] In other contexts, T-Mobile has argued that excluding AT&T and Verizon would raise auction proceeds. The argument is that others are afraid of bidding against AT&T and Verizon, but willing to participate in an auction that excludes them. That argument is self-contradictory: Any prospective bidder can win spectrum in an open auction by providing the highest bid. If others are willing to pay more than AT&T and Verizon, which is the only way an auction could raise more in their absence than in their presence, then the other prospective bidders have nothing to fear from AT&T and Verizon's presence. On the other hand, if others are not willing to pay more, then an auction without AT&T and Verizon will raise less than an auction in which they participate. The sort of irrational bidding behavior that this theory assumes—like gamblers overcome by their addiction, bidders will spend more than they have budgeted if they can only be enticed to enter the fray—cannot be expected from the managements of major corporations who are accountable to their bankers, investors, and boards of directors. T-Mobile's

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If the FCC's goal in the 600MHz auction is to limit excessive spectrum aggregation while maximizing auction proceeds, the spectrum screen can be applied post-auction, after the value of the spectrum has been revealed by open bidding. By following its traditional two-step process, the FCC can optimize proceeds to the Treasury while making appropriate spectrum-aggregation decisions.

premise in the proposal we discuss in this paper—that excluding AT&T and Verizon will lower auction proceeds-- is correct in view of the four national carriers' relative spectrum positions.

[14] Commissioner Jessica Rosenworcel, "Statement re Modernizing the FCC Form 477 Data Program," June 27, 2013.