

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of)
)
Public Notice Requesting Comment on)
Experimental Design for Examining) DA 05-1267
Performance Properties of Simultaneous)
Multiple Round Spectrum License Auctions)
With and Without Combinatorial Bidding)

COMMENTS OF
TELEPHONE AND DATA SYSTEMS, INC. and
UNITED STATES CELLULAR CORPORATION

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SUMMARY

Telephone and Data Systems, Inc. and its subsidiary United States Cellular Corporation (collectively, "TDS") commend the FCC for pursuing improvements to its spectrum auction rules and for inviting comment on alternatives under consideration. TDS has previously filed comments opposing national or super-regional licenses and opposing package bidding rules that could establish such large license areas on a *de facto* basis or otherwise handicap small bidders.

The FCC wisely sought comments on the experimental design proposed by Professors Jacob Goeree and Charles Holt. While it is well intentioned, it has many deep flaws. These comments together with the attached paper by Professor Robert Weber point to specific problems in running and interpreting the proposed experiment. The proposed experiment may provide sufficient evidence to expose flaws in the auction rules being tested, but it cannot be relied upon to prove their efficacy. Results from these simplified experiments may lead the FCC to reject some package auction rules and mechanisms as excessively confusing, conducive to undesirable strategic bidding, tending to expand the duration and undermine the transparency of auctions, and detrimental to small bidders. For example, it is possible that the experiment will reveal serious problems in the algorithm for "current price estimates" for package bids and the related computation of minimum acceptable bids.

More generally, small, simplified experimental auctions with unsophisticated subjects and a few experimenter-selected starting conditions probably will yield unreliable guidance for complex, real-world spectrum auctions. No small-scale, simplified experiment can override the well-founded belief that large-scale package

bidding is unreasonably burdensome for the bidders (especially small bidders), confusing and contrary to the objectives of auction design.

These comments also address the adverse consequences for small bidders if the FCC uses the proposed methodology for simultaneous multiple round auctions with package bidding. As described here, package bidding may discourage participation of small bidders in auctions because of the (a) "threshold" problem, (b) increased likelihood that large bidders will tie-up multiple licenses in nationwide or super-regional package bids, and (c) added auction complexity, in terms of both the mechanisms for navigating the auction itself and the strategies successful bidders will need to employ. Small bidders have served well the aims of Congressional policies for both spectrum auctions and the wireless marketplace. The FCC must not apply any experiment to the detriment of small bidders and the public benefits that they bring to wireless consumers.

Any single experiment should be given limited weight in evaluating and changing the rules that have been used successfully in large-scale FCC auctions based on simultaneous multiple rounds without package bidding, such as the recent Auction 58. In particular, the FCC cannot draw from any experiment that package bidding "works" or better promotes the statutory mandates. There is no evidence that the "exposure" problem has been or will be significant in any real FCC auction. Regardless of the outcome of an experiment, the upcoming auction of Advanced Wireless Spectrum in 1.7/2.1 GHz as well as several other planned auctions will be too large-scale and high-stakes – in value and number of licenses, as well as importance to the industry and public – to apply package bidding.

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Attached paper by Professor Robert Weber

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Comments of Telephone and Data Systems, Inc. and
United States Cellular Corporation

Introduction

Telephone and Data Systems, Inc. and its subsidiary United States Cellular Corporation (collectively, "TDS"), by their attorneys, submit their comments in response to the *Public Notice* "Comment Sought on Experimental Design for Examining Performance Properties of Simultaneous Multiple Round Spectrum License Auctions With and Without Combinatorial Bidding," released on May 2, 2005 (DA 05-1267).

The FCC wisely sought comments on the experimental design proposed by Professors Jacob Goeree and Charles Holt. While it is well intentioned, it has many deep flaws. These comments together with the attached paper by Professor Robert Weber ("Weber Paper") point to specific problems in running and interpreting the proposed experiment. The proposed experiment may provide sufficient evidence to expose flaws in the auction rules being tested, but it cannot be relied upon to prove their efficacy. Results from these simplified experiments may lead the FCC to reject some package auction rules and mechanisms as excessively confusing, conducive to undesirable strategic bidding, tending to expand the duration and undermine the

transparency of auctions, and detrimental to small bidders. For example, it is possible that the experiment will reveal serious problems in the algorithm for "current price estimates" for package bids and related computation of minimum acceptable bids.

More generally, small, simplified experimental auctions with unsophisticated subjects and a few experimenter-selected starting conditions probably will yield unreliable guidance for complex, real-world spectrum auctions. No small-scale, simplified experiment can override the well-founded belief that large-scale package bidding is unreasonably burdensome for the bidders (especially small bidders), confusing and contrary to the objectives of auction design.

These comments also address the adverse consequences for small bidders if the FCC uses the proposed methodology for simultaneous multiple round auctions with package bidding ("SMRPB"). As described here, package bidding may discourage participation of small bidders in auctions because of the (a) "threshold" problem, (b) increased likelihood that large bidders will tie-up multiple licenses in nationwide or super-regional package bids, and (c) added auction complexity, in terms of both the mechanisms for navigating the auction itself and the strategies successful bidders will need to employ. Small bidders have served well the aims of Congressional policies for both spectrum auctions and the wireless marketplace. The FCC must not apply any experiment to the detriment of small bidders and the public benefits that they bring to wireless consumers.

Any single experiment should be given limited weight in evaluating and changing the rules that have been used successfully in large-scale FCC auctions based on simultaneous multiple rounds without package bidding ("SMR"), such as the recent Auction 58. In particular, the FCC cannot draw from any experiment that package

bidding "works" or better promotes the statutory mandates. There is no evidence that the "exposure" problem has been or will be significant in any real FCC auction. Regardless of the outcome of an experiment, the upcoming auction of Advanced Wireless Spectrum in 1.7/2.1 GHz as well as several other planned auctions will be too large-scale and high-stakes – in value and number of licenses, as well as importance to the industry and public – to apply package bidding.

These comments have three sections: (I) issues the FCC should consider in developing and analyzing any package bidding experiment; (II) improving the design of the Goeree/Holt experimental auction; and (III) conclusions for auction rules.

I. Issues the FCC Should Consider in Developing or Analyzing Any Package Bidding Experiment

TDS commends the FCC for pursuing improvements to its spectrum auction rules and for inviting comment on alternatives under consideration. TDS has previously filed comments opposing national or super-regional licenses and opposing package bidding rules that could establish such large license areas on a *de facto* basis or otherwise handicap small bidders.¹

As the FCC considers the design and analysis of auction experiments, the following six issues demand caution in interpreting and applying the results of any single

¹ See, e.g., Ex Parte Presentation and Comments of U.S. Cellular in Service Rules for Advanced Wireless Services in the 1.7 and 2.1 GHz Bands, WT Docket No. 02-353 (Apr. 29, 2005; Dec. 8, 2004; Feb. 7, 2003); Comments of U.S. Cellular in Auction of Licenses in the 747-762 and 777-792 MHz Bands, Report No. AUC-02-31 (Feb. 19, 2002); Comments of U.S. Cellular in Reallocation and Services Rules for the 698-746 MHz Spectrum Band, GN Docket No. 01-74 (May 15, 2001); Reply Comments of TDS in Auction of Licenses in the 747-762 and 777-792 MHz Bands, DA 00-1075 (June 16, 2000).

package bidding experiment. The unifying theme of these issues is that the simplifications necessary for any such experiment fail to provide reliable guidance relative to the multiple dimensions of the statutory standards for and the complexities of real-world spectrum auctions.

1. Congressional mandate to disseminate licenses to small bidders.

Any experimental auction that measures "economic efficiency" in terms of revenue generation or bidders' aggregate willingness to pay for licenses fails to reflect the FCC's statutory requirements in designing spectrum auctions. Congress directed the FCC in auctioning spectrum licenses to promote "economic opportunity and competition" and to disseminate licenses "among a wide variety of applicants, including small businesses, rural telephone companies, and businesses owned by members of minority groups and women." 47 U.S.C. §§ 309(j)(3)(B), 309(j)(4)(C) and (D).² Regional carriers play important roles in bidding for licenses as well as in advancing the statutory policies to use spectrum efficiently and deploy new technologies in rural areas. 47 U.S.C. § 309(j)(3)(A) and (D).³ Also, Congress prohibited the FCC from basing its area and

² The FCC uses the selection of geographic services areas for specific frequency bands and channelizations to promote economic opportunities for small bidders and regional carriers as well as competition. See Reallocation and Service Rules for the 698-746 MHz Spectrum Band, 17 FCC Rcd 1022, at 1061 (2002); Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands, 18 FCC Rcd 25162, 25175-76 (2003).

³ The FCC has recognized the important contributions of several regional carriers to competition, technology advances, and innovative service and pricing offerings. See Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993 (Ninth Report), 19 FCC Rcd 20597, 20658, 20659, 20685 (2004); Applications of AT&T Wireless Services, Inc. and Cingular Wireless Corp., 19 FCC Rcd 21522, 21564, 21591 (2004).

U.S. Cellular has been a leader in deploying certain advanced wireless technologies. See "Mobile AOL Instant Messenger (AIM) Service Now Available to U.S. Cellular Customers" (USCC press release, Mar. 15, 2005); "Novarra's nweb for easyedge is a hit (*Footnote continued next page*)

bandwidth designations solely or predominantly on the expectation of Federal revenues.

47 U.S.C. § 309(j)(7)(A).⁴

It is not sufficient merely to include some hypothetical small bidders with hypothetical budgets and valuations in a short experimental auction where the outcome is analyzed only in terms of "economic efficiency" across the valuations of all bidders. In addition to the harm to small bidders from package bidding's "threshold" problem, real-world auctions with package bidding and sophisticated bidders may lead to subtle strategies and risks that are adverse to small bidders. See example in Weber Paper at 3-6 showing the disproportionate strategic burden placed on small bidders by the proposed package bidding rules for the experiment. Because of the diversity of real-world bidders and the large range of possible bidding strategies and confusions, any small-scale

for U.S. Cellular" (USCC press release, Mar. 11, 2005). U.S. Cellular maintains one of the industry's highest levels of customer satisfaction by emphasizing customer support, quality network coverage and comprehensive range of wireless products and services.

See Weber Paper at 2 (long-term benefits of diverse wireless carriers in technology deployment and competition). Similarly, Professor William Rogerson (former Chief Economist of the FCC) concluded: "Regional/rural carriers serving small geographic areas provide an important source of competition, variety, and diversity in rural and less dense areas. Auctioning spectrum in geographic blocks too large for these carriers to use would disadvantage these carriers and thereby harm consumers in less dense and rural areas that depend upon them." (paper attached to comments filed by U.S. Cellular in GN Docket No. 01-74 (May 15, 2001)).

⁴ In addition to this deficiency in the Goeree/Holt proposal discussed in Section II.1 infra, other experiments related to FCC auctions that evidence incomplete consideration of the Congressional mandates (with no attention to the policy of promoting the dissemination of licenses to small bidders) include: Cybernomics, "An Experimental Comparison of the Simultaneous Multi-Round Auction and the CRA Combinatorial Auction," at 13-19 (March 15, 2000) (presented at the FCC's Combinatorial Bidding Conference May 5-7, 2000); J. Banks, et al., "Theory, Experiment and the Federal Communications Commission Spectrum Auctions," at Section 2.2 (presented at the FCC's Combinatorial Bidding Conference Oct. 26-28, 2001); D. Porter, et al., "Combinatorial Auction Design," at 4-5 (June 17, 2003) (presented at the FCC's Combinatorial Bidding Conference Nov. 21-23, 2003).

experimental auction is unlikely to cast light on many of the real-world effects of potential auction rules on the Congressional mandate to promote opportunities for small bidders.

2. Complexities of Real-World Scale. The likely real-world scale of a major U.S. spectrum auction far exceeds the proposed experiment or any such experiment in number of bidders, number of simultaneously auctioned licenses, duration, bidding strategies and other important features. For example, the recently-completed Auction 58 had 35 bidders who qualified to participate, bidding on 217 licenses, and 91 rounds over 15 days. Any guidance for a large, complex, high-stakes auction coming from a small, simplified experiment must be weak. Professor Paul Klemperer observed: "Good auction design is not 'one size fits all.' It must be sensitive to the details of the context." P. Klemperer, "What Really Matters in Auction Design", 16 J. Econ. Perspectives 169, at 184 (2002) (citing designs that "performed extremely well in laboratory experiments in both efficiency and revenue generation" but failed in real-world auctions where the number of licenses and bidders varied from the experiment).

Professors Lawrence Ausubel and Paul Milgrom have warned the FCC about the likely gap between conduct in experiments and strategies in FCC auctions:⁵

The Cybernomics experimental setting may also have offered less scope for strategic manipulation of the rules than the FCC auction setting There are cogent reasons to believe that, if the rules of the experimental setting were duplicated exactly, bidders in a real, high stakes auction would bid differently than the subjects in the Cybernomics experiment. Indeed, the serious strategic analysis that experimental subjects could not make in the allotted time but that some FCC bidders will make reveals unexpected profit opportunities. The optimality of the "slow" bidding

⁵ L. Ausubel & P. Milgrom, "Ascending Auctions with Package Bidding," at 10, 27 (June 7, 2001) (presented at the FCC's Combinatorial Bidding Conference Oct. 26-28, 2001).

strategies and the possibility of coordinated bidding equilibria are two such opportunities.

A small, short, simplified experiment cannot be relied on to reveal the real-world strengths and weaknesses of auction rules.

As for package bidding rules, the FCC for Auction 31 limited the number of package bids that any bidder could make in order to control the confusion to bidders and opportunities for "parking" and other undesirable strategies arising from package bids. The FCC observed that "allowing an unlimited number of packages would be needlessly complex, and could facilitate strategic bidding. It is highly unlikely that any serious bidder actually needs to bid on all 4,095 combinations of licenses that are possible in this auction."⁶ The FCC cannot conclude from one or more small-scale experiments involving a few potential packages that large-scale package bidding "works" or generally leads to FCC auction results which better promote the statutory objectives than SMR auctions without package bidding.⁷ Unfortunately, the lack of interest in Auction 51 did not yield useful real-world information on package bidding,⁸ and Auction 31 has been delayed.

⁶ Auction for Licenses in the 747-762 and 777-792 MHz Bands, 15 FCC Rcd 11526, at 11532 (2000) ("Auction 31").

⁷ See Weber Paper at 2 ("[T]o conclude that one auction format is 'good,' or, at least, better than another on the basis of such experiments would be ill-advised."). The FCC clearly erred in 2000 when it extrapolated the "evidence" resulting from limited, small-scale auction experiments to claim: "Experiments and tests were completed this spring demonstrating that combinatorial bidding is feasible and generally leads to more efficient auction results." Auction 31, supra, 15 FCC Rcd at 11535.

⁸ Moreover, no comments were filed on package bidding for Auction 51. Auction of Regional Narrowband PCS Licenses Scheduled for September 24, 2003, DA 03-1994, at 21 (June 18, 2003).

3. Some Forms of Tacit Collusion Likely to Evade Experimenters.

Professors Goeree and Holt recognize that tacit collusion is an important consideration in auction design.⁹ However, some important forms of tacit collusion may emerge from bidders' repeated participation in FCC auctions, on-going relationships among bidders and sophisticated signaling that are difficult to test in a short experiment with unsophisticated subjects.¹⁰

4. Sophisticated Real-World Bidding Strategies. Real-world bidders

have the sophistication to use diverse auction strategies, such as straightforward bidders versus strategic bidders employing "parking" bids and other strategies. The economic studies of real-world auctions cited in the preceding paragraph describe subtle strategies that shaped outcomes. As Professors Weber, Ausubel and Milgrom observed, subjects in a bidding experiment are unlikely to have the sophistication or time to formulate or apply diverse auction strategies.¹¹ With limited budgets and localized demands, small bidders are particularly vulnerable to some strategies that are likely to go untested in an

⁹ J. Goeree & C. Holt, "Comparing the FCC's Combinatorial and Non-Combinatorial Simultaneous Multiple Round Auctions: Experimental Design Report", at 10-11 (Apr. 27, 2005, attached to Public Notice DA 05-1267).

¹⁰ See R. Weber, "Making More from Less: Strategic Demand Reduction in the FCC Spectrum Auctions", 6 J. Econ. & Management Strategy 529 (1997); P. Crampton & J. Schwartz, "Collusive Bidding: Lessons from the FCC Spectrum Auctions", 17 J. Regulatory Econ. 229 (2000); P. Klemperer, "Using and Abusing Economic Theory", CEPR Discussion Paper No. 3813 (2003) (describing an experiment that failed to produce the tacit collusion that was evident in Germany's actual DCS-1800 auction).

¹¹ Weber Paper at 3 ("I see no way in which the current experiment will lead to a measure of the computational and strategic burden smaller firms would face in a real spectrum auction."); Weber Paper at 6 ("[w]ithout substantial pre-auction discussion of alternative strategies, and supporting exploratory aids . . . it is likely that most of the subjects will fall back upon 'nonstrategic' bidding In consequence, the progress and outcomes of the experimental auctions would be very misrepresentative of how actual spectrum auctions would play out."); Ausubel & Milgrom, supra, at 10, 27.

experiment but will be apparent to the teams assembled by large, experienced bidders in real FCC auctions. Of particular concern to small bidders is that the "threshold" problem of package bidding for large-scale FCC auctions cannot be effectively tested in a small, short, simplified experiment.

5. Payments to Subjects of Experiments Do Not Reflect Real-World Incentives. The incentives and rewards to bidders in real-world auctions are complex and not even remotely reproduced in the payment for participating in a laboratory experiment for a few hours. Yet, these incentives and rewards influence the "threshold" problem and other aspects of auction design. Even if experimenters could develop "realistic" valuations and budgets for bidders, the financial incentives for subjects who take a couple of hours to earn a few dollars in an experiment cannot be expected to lead to reliable guidance for real FCC auctions when the stakes are in the billions of dollars and the success or failure of careers.¹²

6. Experimenters Cannot Reflect Many Considerations That Shape Auctions. Knowing that the valuations and budgets they assign to hypothetical bidders will shape the outcome of the experimental auction, experimenters struggle to assign "realistic" values. But, how accurate can they be? With each FCC auction (including Auction 51 which failed to attract significant interest), there were major details of the actual competitive environment (as to number of bidders, valuations, strategies, duration, etc.) which were not revealed until the auction took place.¹³ There are many evolving

¹² See Weber Paper at 1; Ausubel & Milgrom, supra, at 10, 27.

¹³ See Porter, supra, at 2 (results in various FCC auctions "revealed some interesting perverse strategies").

characteristics of future FCC bidders that cannot be reflected "realistically" in experiments before the actual auctions are conducted.

It is impossible to eliminate the bias introduced by experimenters as they select experimental parameters. The FCC must protect against allowing the experimenters' guesses as to "realistic" features to shape rules for FCC auctions which would discourage effective participation by small bidders.

Real-world bidders shape their strategies based on substitutes, complements and other intertemporal considerations going beyond a single auction in a laboratory experiment – gaps in their existing licensed footprint; licenses available in scheduled and upcoming unscheduled auctions; ability to acquire licenses through transfers; ability to transfer all or portions of acquired or existing licenses, including through geographical partitions and spectrum disaggregation; etc. Also, interrelated considerations across bidders, or "affiliated" information -- like information about their competitors' financial resources and aspirations, or service alliances between carriers -- are not reflected merely in the private values and common values in a laboratory experiment.¹⁴

Along the same lines, the FCC recently noted with regard to its experimental economics study of media ownership rules that the study "did not model some potentially important aspects of the industry" and is "imprecise in determining the

¹⁴ See Weber Paper at 5; Ausubel & Milgrom, supra, at 10 ("the experimental subjects' lack of information about other bidders' values is not typical of FCC spectrum auctions and make it harder for them to exploit the strategic opportunities that the auction affords").

point at which [increased bargaining power from increased horizontal size] impedes the flow of programming".¹⁵

In summary, with all of these limitations and concerns, an auction experiment could conceivably provide information weighing against some potential aspects of auction designs, such as excessively confusing or analytically intractable package bidding rules.¹⁶ However, it would be hazardous to draw any support from such an auction experiment for potential auction rules. No small-scale experiment can override the well-founded belief that large-scale package bidding is unreasonably burdensome for bidders (especially small bidders), confusing and contrary to the objectives of auction design.¹⁷

II. Improving the Design of the Goeree/Holt Experimental Auction

The particular auction experiment proposal by Professors Goeree and Holt is deeply flawed and should be improved in at least nine ways.

¹⁵ The Commission's Horizontal and Vertical Cable Ownership Limits, MM Dkt. No. 92-264, Second Further Notice of Proposed Rulemaking, at 9 (rel. May 17, 2005).

¹⁶ See Banks, supra, at Summary ("Elementary errors and their correction in mechanism design should be made in the laboratory, not in the field . . .").

¹⁷ Auction 31, supra, 15 FCC Rcd at 11532; Cyberronomics, supra, at 18-19 ("One proposed factor in evaluating auctions is their duration. A reasonable assumption is that longer auctions should be avoided *ceteris paribus*. This reduces the transaction costs faced by bidders and the auctioneer, and thus potentially raises effective valuations and net revenues Result 5 [of the experiments]: The [package bidding] auction takes over 3 times as long as the SMR to finish."); Banks, supra, at Summary ("One of the primary objectives of auction design should be to simplify, and reduce the cost of the bidding process for the participants The auction should not obligate bidders to expend an inordinate amount of resources on consultant and management time trying to figure out how to bid strategically in order to realize their potential value."); Ausubel & Milgrom, supra, at 27 (ascending package auction was "much too long for practical use" and vulnerable "to coordinated strategies in which bidders retaliate by driving up prices of those who do not bid as required").

1. Performance Measurers. The outcome should be measured in more dimensions than economic efficiency across all bidders and revenue generation.¹⁸ Distribution of licenses to small bidders and the ability of small bidders to obtain the licenses they value most are important statutory mandates and measures of an auction design. The performance measures should also address whether the auction rules fostered bidding strategies adverse to small bidders or increased computational and strategic burdens for small bidders (see Weber Paper at 2, 3), led to super-regional aggregations, etc.

In addition, much of the theoretical impetus for package bidding is based on the "exposure" problem. The "threshold" problem is a concern working against package bidding. Although an experiment cannot give reliable guidance for how these problems would play out in real FCC auctions (and there is no evidence that the "exposure" problem as been or will be significant in any real FCC auction), performance measures on experiments should attempt to analyze the effects of different auction rules on these problems.

2. Time. Bidders need more time for training, developing strategies and formulating bids in each round. It is attractive to imagine that an auction experiment could get a subject in and out in "perhaps 2 hours or more, [addressing] the need to explain complex procedures and obtain enough replications."¹⁹ But, this short exercise would likely yield misleading guidance on real-world auction issues, especially when

¹⁸ Goeree & Holt, supra, at 13.

¹⁹ Id. at 12. Compare Cybernomics, supra, at 11 (five hours of training prior to participation in combinatorial auctions).

seeking to evaluate complex strategies related to package bidding.²⁰ In connection with allowing limited package bidding in Auction 31, the FCC found: "We believe that [two months] is sufficient for bidders to understand the package bidding procedures and to develop appropriate auction strategies We also plan on extensive bidder education efforts and will be available both before and during the auction to answer any questions bidders might have."²¹ Compare two months for preparation for a real FCC auction to just a few hours to explain and run an experiment with subjects who are novices in auctions.

3. Current Price Estimates. The complex proposed rules for calculating minimum acceptable bids and bidding increments based on "current price estimates"²² foster strategic behavior that can be adverse to small bidders and cause confusion, as explained in Weber Paper at 3-6. If the experiment does not reveal these problems because bidders act "nonstrategically", it may be due to the experiment's inadequate training, time and sophistication of the subjects. Concerns about

²⁰ See Weber Paper at 1, 6; criticism of procedures in a prior auction experiment in Ausubel & Milgrom, supra, at 10:

[R]ounds were relatively short, affording subjects little opportunity to evaluate others' bids and assess the strategic opportunities. Third, the relatively long training sessions that subjects required seemed to highlight their difficulty in understanding the rules, further limiting their ability to exploit gaps in the rules. Long as these sessions were, they fall far short of the preparation undertaken by bidders in the FCC auctions, where the stakes are also very much higher. Finally, unlike bidders in the FCC auction, subjects in the experiments had no access to expert assistance or to analyses that could pinpoint opportunities for strategic bidding.

²¹ Auction 31, supra, 15 FCC Rcd at 11535-36.

²² Goeree & Holt, supra, at 20, 23.

disadvantages to small bidders from this auction design cannot be dispelled by a short, simplified experiment.

Also, the experiment should study the effects of different amounts of initial eligibility to be awarded each participant.²³

4. Inconsistencies. There are inconsistencies in the proposed rules for SMR and package bidding auctions, as well as unspecified details left to the experimenters' discretion, in several areas -- calculation of minimum acceptable bids and bid increments, payment default rule, bidding activity rule, bid withdrawal and payment default rules.²⁴ These differences further limit the usefulness of any data collected from the experiment.

5. Subjects. Professors Goeree and Holt do not describe the source of the subjects for the experiment. Novices (such as undergraduates) are less likely to perceive or pursue the strategic opportunities allowed by the package bidding rules, but such strategic bidding would likely emerge with sophisticated bidders in real auctions. See Sections I.2-4, supra. Perhaps the experiments should test the outcomes of auctions with all novice subjects, versus all experienced bidders, versus mixes of novices and experienced bidders.

6. Compensation. Bidders should have more realistic incentives and rewards for successful bids. Professors Goeree and Holt do not provide details of the success-based portion of the subjects' compensation, but recognize that "[f]inancial

²³ See Cybernomics, supra, at 25.

²⁴ Goeree & Holt, supra, at 20-24.

motivation should be high enough to merit serious consideration."²⁵ Subjects representing small bidders should not be disadvantaged in compensation and should be motivated to work through difficult options. In an experimental auction, a subject with experience bidding in a real FCC auction has stronger incentives to win bragging rights in his firm or professional group than an undergraduate who can earn about \$20 more by winning.

7. Bidding Information. The experiment should test the effects of different presentations of bidding information or "client interfaces".²⁶ Different client interfaces may affect bidding strategies, perhaps more so for small bidders. Large bidders are more likely to take the "raw data" and create their own analytic tools, "dashboards" and interfaces. Experimenters should test how to provide bidding information so that greater auction complexity does not disadvantage small bidders. Auction 51 did not effectively test the contents and formats of the various downloadable files the FCC provided to facilitate the package bidding.²⁷

8. Limits on Packages. The experiment should test the effects of different limits on package bidding, such as on the number of packages on which any participant can bid, or on the population covered by any package bid. The FCC's rules for Auction 31 would allow bidders to self-define a limited number of packages from a large range of potential packages; the FCC rejected the approach of having a pre-set

²⁵ Id. at 12.

²⁶ Id. at 8. See Banks, supra, at Summary (importance of computational support to bidders).

²⁷ Auction of Regional Narrowband PCS Licenses Scheduled for September 24, 2003 (Auction No. 51), DA 03-2522, at 3-9 (July 29, 2003).

group of packages chosen by the FCC as too confining on bidders.²⁸ Consistent with the FCC's observation in adopting rules for Auction 31, the experiment's performance measures must be sensitive to bidder confusion and strategies.

9. Spectrum Aggregation Limits. In ending its CMRS spectrum aggregation limits, the FCC cited its "ability to shape the initial distribution of licenses through service rules adopted with respect to specific auctions" as one of the tools it could employ to promote competition.²⁹ Excessive concentration of spectrum resources is not in the public interest. In light of the consolidation of wireless carriers and the divestitures required by the FCC,³⁰ the experiment should collect data on the effects of various spectrum aggregation limits in auction rules on which entities win licenses in auctions and the winning license configurations.

III. Conclusions for Auction Rules

The FCC's auction rules are critically important to bidders, wireless carriers, wireless users and the multiple statutory goals, including disseminating licenses to small bidders.

In furtherance of its statutory mandates, the FCC has adopted channelization and service area designations for spectrum subject to auction which preserve licensing opportunities for small bidders; the FCC recognized that regional carriers promote technological advances, innovative offerings and competition, especially

²⁸ Auction 31, supra, 15 FCC Rcd at 11532.

²⁹ 2000 Biennial Regulatory Review: Spectrum Aggregation Limits for Commercial Mobile Radio Services, 16 FCC Rcd 22668, at 22680 (2001).

³⁰ See Applications of AT&T Wireless Services and Cingular Wireless, 19 FCC Rcd 21522 (2004).

in rural areas.³¹ It would be a sad irony if the FCC's auction rules unfairly impair or prevent these small bidders from obtaining the spectrum resources they need.

In adopting auction rules, the FCC must not be misled by a short, small, simplified experiment. There are inherent problems in any package bidding experiment intended to test the rules for real-world, large-scale FCC auctions.

The proposed experiment by Professors Goeree and Holt has deep flaws. These comments point to many specific problems in running and interpreting the proposed experiment. An experiment can be useful in rejecting some of the burdensome, confusing, obscure aspects of the proposed auction rules.

The FCC's efforts to improve its auction rules and address the special conditions of specific auctions should be based on a combination of its experience with prior auctions, comments from potential bidders, evaluation of other real-world auction experiences, and lessons from auction economists (based on laboratory experiments as well as theory). Any single experiment should be given limited weight in evaluating and changing the rules that have been used successfully in large-scale FCC auctions based on SMR without package bidding, such as the recent Auction 58.

³¹ See Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands, 18 FCC Rcd 25162, 25175-76 (2003).

In particular, the FCC cannot draw from any experiment that package bidding "works" or better promotes the statutory mandates. There is no evidence that the "exposure" problem has been or will be significant in any real FCC auction. Regardless of the outcome of an experiment, the upcoming auction of Advanced Wireless Spectrum in 1.7/2.1 GHz as well as several other planned auctions will be too large-scale and high-stakes -- in value and number of licenses, as well as importance to the industry and public -- to apply package bidding.

Respectfully submitted,

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**Comments on Public Notice (DA 05-1267): “Comment Sought on
Experimental Design for Examining Performance Properties of
Simultaneous Multiple Round Spectrum License Auctions
With and Without Combinatorial Bidding”**

Robert J. Weber*

A General Warning

One must be very careful in trying to interpret laboratory-based experimental results in a positive practical light. For example, I've run a simple single-item auction experiment on an annual basis for nearly 20 years. The participants in these experiments face little time pressure (they have at least 24 hours in which to make a single bidding decision). They are experienced, well-trained, talented managers (ranging from soon-to-graduate MBA students to professional investment bankers). Still, in a setting where theory predicts the same expected revenues from both first-price and second-price sealed-bid auctions *in a rational world*, I consistently obtain appreciably higher revenues from first-price auctions. Vernon Smith and others have obtained similar results.

I might well, on the basis of these experimental results, advise a seller to favor one auction format over another *if* the auction were to be held once, with modest stakes, and with individual bidders who lacked experience with sealed-bid auctions. But I would be very reluctant to give advice based on these results, if millions of dollars were on the line and most of the bidders, working in teams, had access to professional advice concerning their bidding strategies.

Economic laboratory experiments most frequently are useful in discovering and exploring negative issues: Cases where subjects' "gut" instincts lead them to behave in manners

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His general area of research is game theory, with a primary focus on the effects of private information in competitive settings. Much of his research has been centered on the theory and practice of competitive bidding and auction design. His 1982 paper, "A Theory of Auctions and Competitive Bidding" (*Econometrica* 50, co-authored with P.R. Milgrom), is considered a seminal work in the field. He served as an external consultant on a 1985 project leading to revisions in the procedures used to auction petroleum extraction leases on the U.S. outer continental shelf, and he co-organized (with representatives of the Federal Reserve Board and the U.S. Treasury) the 1992 public forum which led to changes in the way the Treasury auctions its debt issues. He has represented private clients during both the rule-making and bidding phases of the FCC's sale of licenses of spectrum for the provision of personal communications services.

different from the way teams of professionals in sizable enterprises should – and usually do – act.

The proposed experiments can certainly be of assistance to the FCC, if they serve to demonstrate problems in the tested auction designs. But to conclude that one auction format is “good,” or at least, better than another, on the basis of such experiments would be ill-advised.

Merely to *understand* the details of the proposed package-bidding procedure has taken me a number of days. Developing an effective bidding strategy for a client would take even longer. To expect over 900 individual subjects to master the details of a complex auction procedure, and then develop strategies that would accurately represent the behavior of telecommunications firms, and carry those strategies out, all in the course of a couple of hours, is unreasonable. And therefore, the FCC must be very wary of drawing any affirmative conclusions from experiments of the type proposed here. The following “example” sections explore this issue in greater detail.

Evaluative measures

The experiment proposal duly notes some of the challenges facing smaller bidders (those with limited interests or budgets) in the package-bidding environment, and proposes some methods for examining the experimental results with respect to smaller bidders in particular. Yet most of the evaluative measures focus on “efficiency,” i.e., on whether licenses (or packages of licenses) end up being allocated to those who assign the greatest economic value to them.

Certainly, the Commission is aware of the dangers of equating this notion of efficiency with the general public welfare. For example, a monopolist typically reaps greater economic gain from control of a market than would several competitors sharing that market. Yet competition, of course, benefits consumers in many ways, ranging from the direct benefit of lower prices and more diverse choices, to the longer-term benefit of diversifying, and ultimately speeding, the development and deployment of new alternative technologies in a rapidly-evolving field of services. ***The measure of efficiency proposed as the primary evaluative method offers no way to capture these important public-welfare-related issues.***

Efficiency “percentages” should generally be viewed with suspicion, since they incorporate underlying fixed costs. An experiment with bidder valuations ranging from 1 to 10 might yield a seemingly dramatic difference in the percentage of efficiency achieved by two auctions, while the same experiment, incorporating a similar range of valuations between 10,001 and 10,010, and with the same allocational results, might show a negligible difference.

Smaller firms face both computational and strategic challenges – arising from both the threshold problem in general, and the specific rules proposed for study – to a much

greater degree, under the proposed package-bidding system than do larger firms. *I see no way in which the current experiment will lead to a measure of the computational and strategic burden smaller firms would face in a real spectrum auction.* Again, I explore these issues in more detail in the next sections.

An Example of the Strategic Challenges Faced by “Smaller” Bidders under Package Bidding

A primary impetus behind the development of package-bidding methodologies is the perception that “larger” bidders (i.e., those with widespread aspirations) seeking a group of complementary licenses may sometimes face an “exposure” problem if the licenses are sold independently.

The difficulty with developing a dynamic package-bidding procedure is that, in ameliorating the exposure problem for larger bidders, a new “threshold” problem is created for “smaller” bidders (i.e., those with local, regional, or budget-constrained aspirations). While the Vickrey-Clarke-Groves procedure (not under consideration in the proposed experiment) uses a pricing rule which eliminates the threshold problem in some economic contexts, most alternatives that have been proposed force smaller bidders to allocate, through their bidding strategies, the joint cost imposed by the need to beat a bid on a package of licenses.

Needing to deal with the threshold problem imposes a complex strategic burden on smaller bidders. *It is not clear that the proposed experiment, in its structure and in the time and advice provided to subjects, will be able to reveal and evaluate the challenges faced by smaller bidders.*

The Example

Consider one simple economic environment. Three bidders (A, B, and C) bid for two licenses (X and Y). A is willing to pay up to 24 for license X, B is willing to pay up to 24 for Y, and C wants only the package XY, and is willing to pay up to 36 for it. The FCC sets minimum opening bids of 10 for both licenses, and uses a minimum bid increment of 10% (with no price smoothing).

One approach a bidder can take in this auction is to bid “nonstrategically,” i.e., to simply remain active at minimum bid levels on the license or package which, at current prices, offers the greatest economic value to the bidder. If all of the bidders act nonstrategically, the auction will progress as in Table 1:

round	minimum acceptable bids (entering round)			Bids						price estimates (leaving round)		
	X	Y	XY	X	who	Y	Who	XY	who	X	Y	XY
0	-	-	-	10.00	FCC	10.00	FCC	20.00	FCC	10.00	10.00	20.00
1	10.00	10.00	20.00	10.00	A	10.00	B	20.00	C	10.00	10.00	20.00
2	11.00	11.00	22.00	11.00	A	11.00	B			11.00	11.00	22.00
3	12.10	12.10	24.20					24.20	C	12.10	12.10	24.20
4	13.31	13.31	26.62	13.31	A	13.31	B			13.31	13.31	26.62
5	14.64	14.64	29.28					29.28	C	14.64	14.64	29.28
6	16.11	16.11	32.21	16.11	A	16.11	B			16.11	16.11	32.21
7	17.72	17.72	35.43					35.43	C	17.72	17.72	35.43
8	19.49	19.49	38.97	19.49	A	19.49	B			19.49	19.49	38.97
	21.44	21.44	42.87									

(Provisionally winning bids in each round are boldfaced; in round 1, a tiebreak makes C's bid the provisional winner.)

While the results look reasonable, the assumption of nonstrategic bidding isn't. If bidder A assumes that the other bidders will bid nonstrategically, then A can improve his own outcome by temporarily bidding on license Y with B, as Table 2 shows:

round	minimum acceptable bids (entering round)			bids						price estimates (leaving round)		
	X	Y	XY	X	who	Y	who	XY	who	X	Y	XY
0	-	-	-	10.00	FCC	10.00	FCC	20.00	FCC	10.00	10.00	20.00
1	10.00	10.00	20.00	10.00	A	10.00	B	20.00	C	10.00	10.00	20.00
2	11.00	11.00	22.00	11.00	A	11.00	B			11.00	11.00	22.00
3	12.10	12.10	24.20					24.20	C	12.10	12.10	24.20
4	13.31	13.31	26.62	11.00	(A)	13.31	A,B			11.00	13.31	24.31
5	12.10	14.64	26.74					26.74	C	12.22	14.53	26.74
6	13.44	15.98	29.42	13.44	A	15.98	B			13.44	15.98	29.42
7	14.78	17.58	32.36					32.36	C	14.91	17.45	32.36
8	16.40	19.19	35.59	16.40	A	19.19	B			16.40	19.19	35.59
	18.04	21.11	39.15									

(In round 4, A bids for license Y, and A's previous bid on X is "resurrected" and combined with B's current bid on Y to yield the provisionally-winning bids. A's provisionally winning bid on X preserves A's "activity" in round 5. [If I'm making a faulty assumption concerning the activity rule here, let A bid 14.64 for license Y in round 5 – Little of substance changes.]

Of course, A could be more aggressive, and "ride" license Y for several rounds, leading to a more dramatic final result (Table 3):

round	minimum acceptable bids (entering round)			bids						price estimates (leaving round)		
	X	Y	XY	X	who	Y	who	XY	who	X	Y	XY
0	-	-	-	10.00	FCC	10.00	FCC	20.00	FCC	10.00	10.00	20.00
1	10.00	10.00	20.00	10.00	A	10.00	B	20.00	C	10.00	10.00	20.00
2	11.00	11.00	22.00	11.00	A	11.00	B			11.00	11.00	22.00
3	12.10	12.10	24.20					24.20	C	12.10	12.10	24.20
4	13.31	13.31	26.62	11.00	(A)	13.31	A,B			11.00	13.31	24.31
5	12.10	14.64	26.74					26.74	C	12.22	14.53	26.74
6	13.44	15.98	29.42	11.00	(A)	15.98	A,B			11.00	15.98	26.98
7	12.10	17.58	29.68					29.68	C	12.35	17.33	29.68
8	13.58	19.06	32.64	11.00	(A)	19.06	A,B			11.00	19.06	30.06
9	12.10	20.97	33.07					33.07	C	12.50	20.56	33.07
10	13.75	22.62	36.37	13.75	A	22.62	B			13.75	22.62	36.37
	15.13	24.88	40.01									

(Again, A could also submit minimum bids on Y in rounds 5, 7, and 9, if needed to preserve eligibility.)

Various levels of price smoothing, or assumptions concerning which bids determine constraints in the pseudo-dual problem (for example, in round 4, the two identical bids on license Y might constitute a single constraint, or two constraints with separate dual variables), change the results slightly, but not substantively.¹

These examples merely scratch the surface of the challenges smaller bidders face in dealing with the threshold problem. For example, B might respond to A's actions by bidding on X. (How bizarre, to have two bidders, each bidding for a license it doesn't want!) With more licenses and bidders, the situation becomes even more complex.

Discussion of the Example

This example raises two important issues:

1. In a real spectrum auction, bidders have substantial information concerning the existing footprints and financial resources of other bidders, and therefore can anticipate (to some extent) other bidders' aspirations. The previous examples illustrate the potential importance of such information in formulating a bidding strategy.

From the description of the proposed experiment, it is not clear whether subjects will be given prior information concerning their competitors. If they are not, then their strategic opportunities (and challenges) will be artificially limited, relative to the opportunities (and challenges) facing firms in a real auction.

¹ Of course, if my calculations are grossly incorrect, this illustrates some combination of my personal failings and the need for a clearer exposition of the proposed rules.

2. The experiment proposal refers to the need for experimental sessions to be “somewhat long – perhaps 2 hours or more.” It seems unlikely to me that subjects could merely be brought to an understanding of the underlying auction procedure, let alone analyze their positions and fully explore their strategic opportunities and then bid for a number of rounds, in such a short period of time.

The proposal acknowledges that “an important question is whether aids should be provided to experimental subjects to help them make thoughtful decisions in complex environments.” However, the subsequent discussion of such aids focuses only on the presentation of current information. It seems to me that, without substantial pre-auction discussion of alternative strategies, and supporting exploratory aids (so that subjects can clearly evaluate the potential consequences of their bids before selecting particular bids), it is likely that most of the subjects will fall back upon “nonstrategic” bidding, as described earlier in the first “example” section. In consequence, the progress and outcomes of the experimental auctions would be very misrepresentative of how actual spectrum auctions would play out.

Summary

I have no intention to argue that the experiment, as proposed, might not yield some interesting insights into prospective problems with one or the other of the tested auction procedures. Rather, these observations are intended to reinforce the previously-stated warning about trying to interpret the experimental results as having any bearing on the positive, practical desirability of the use of one procedure over another by the FCC.

Respectfully submitted by Robert J. Weber