

Auctions for Radio Spectrum (D): Second-Price Simultaneous Ascending Auctions

LIANGLIANG JIANG¹
MARK A. JAMISON

The simultaneous ascending auction has become a standard approach to spectrum auctions. The U.S. Federal Communications Commission (FCC) uses this approach, which is favored by many game theorists.

- Multiple licenses are opened for bidding at the same time and remain open so long as there is bidding on any of the licenses.
- Bidding occurs over rounds, with the results of each round announced to the bidders before the start of the next round.
- Bidding is done by computer, online.
- Rules are detailed, amounting to approximately 130 pages.

Why are simultaneous ascending auctions of this form so popular among game theorists?

- The licenses are interdependent, either substitutes or complements. (Licenses can be substitutes in the sense that they offer the same market opportunities. They may also be complements in the sense that, for example, two licenses for separate geographic areas are more valuable for an operator that has both licenses than for two operators that each has one of the licenses.)
- Auctioning multiple licenses improves efficiency (assigning licenses to the firms most willing and able to use them), and the aggregation of licenses across geographic areas is determined by the competition.
- Ascending bids allow bidders to see how

highly their rivals value each license and which aggregations they seek.

- The risk of suffering a “winner’s curse” is diminished, leading to high bids. (The winner’s curse is the situation where the winner of an auction has overpaid because he overestimated the value of the product.)
- Simultaneous bidding allows bidders to switch to back-up aggregation strategies in light of others’ higher valuation.

Context for the Simulation

The country United People (U.P.) is assigning radio spectrum for new third generation (3G) mobile services. U.P. successfully liberalized telecommunications 15 years ago by opening its fixed line market to competition and licensing three mobile operators for second generation (2G) mobile services. The incumbent fixed line operator, UPTel, received one of the mobile licenses. The other licenses went to OneMobile and NewMobile, both of which were newly formed telecom operators at the time. The demand for telecommunications services was much greater than anyone had anticipated in U.P., so UPTel, OneMobile, and NewMobile all experienced impressive growth – so much so that there are now enough 2G mobile phones in U.P. for 60 percent of the citizens to have their own personal 2G phone.

The industry regulator, U.P. Communications

¹ The authors are Research Associate and Director, respectively, PURC, University of Florida, PO Box 117142, Gainesville, Florida 32611-7142, USA, <http://www.purc.ufl.edu>. The authors wish to thank Andrew Nahlik and Janice Hauge for their helpful comments and Patricia Casey for her editing work.

Commission or UPCOM, is in charge of the 3G spectrum auction. It has prequalified six companies to bid on a total of five 3G licenses. The licenses vary in their bandwidth, location in the radio spectrum, and number of current users who would need to relocate. UPCOM has alerted the current users that they will need to move to different frequencies in the radio spectrum. However, it is up to each winner of a 3G license to negotiate with the current user(s) of its frequency on when and under what financial terms the current user will move to a different frequency. Exhibit 1 provides details.

All three incumbents have qualified to bid on 3G licenses, as did FourCom (a newly formed telecommunications company financed by local bankers), TopCom (a mobile carrier from a neighboring country), and BigCom (an international mobile carrier that provides service in many developed countries). Each of the qualified bidders knows its financial capabilities and how much it is willing to pay for each of the five licenses. The qualified bidders vary in their willingness to pay.

Bidding is in UP dollars. UPCOM has researched the market and hopes to raise UP390 million.

Auction Rules

UPCOM has announced that it intends to use an English Second-Price auction. The bidding rules are as follows:

- Each bidder will be awarded at most one license.
- All licenses will be auctioned simultaneously.
- There will be multiple bidding rounds during which all bidders submit their bids simultaneously in each round.
- One bidding round is held every 10 minutes.
- Bids are submitted using the provided forms, which show the license and the bid amount.
- The highest bid on each license becomes

“current.” At the end of each round, UPCOM will announce the “current” bids, but will not announce any other bid amounts.

- Each bidder can bid on as many licenses as it wants in each round.
- Any bidder can choose to sit out a round.
- A bidder with the “current” bid on a license cannot bid on that license again until someone submits a higher bid.
- Bidding continues until no more bids are submitted at which time the auction ends and those with “current” bids pay the next highest bids for the licenses.
- If a bidder holds the “current” bid on more than one license when the auction ends, UPCOM will decide which license the bidder receives. UPCOM will award the bidder’s other license(s) to the next highest bidder on each license.
- If a bidder holds the “current” bid on a license at the end of the auction and does not have the financial resources to pay the next highest bid amount, the bidder is disqualified and UPCOM will award the license to the next highest bidder.
- New entrants can choose to hire a consultant before or during the auction. Consultants provide information on other bidders’ likely willingness to pay on particular licenses.
- Any bidder communicating with another bidder about prices is disqualified and has its financial reserves confiscated.

Note that it is not necessary for each license to receive a bid in each round.

Scoring

At the end of the auction, each qualified bidder will receive points equal to the difference between the bidder’s willingness to pay for the license it wins, minus the amount the bidder paid for the license and minus any consulting fees. Bidders not receiving a license get zero points. □

References

- Cramton, Peter.** 2002. "Spectrum Auctions." In *Handbook of Telecommunications Economics*, Vol. 1, ed. Martin Cave, Sumit Majumdar, and Ingo Vogelsang, 605-639. Amsterdam: Elsevier.
- Cramton, Peter, and Jesse A. Schwartz.** 2000. "Collusive Bidding: Lessons from the FCC Spectrum Auctions." *Journal of Regulatory Economics*, 17(3): 229-252.
- Illing, Gerhard, and Ulrich Klüh,** ed. 2004. *Spectrum Auctions and Competition in Telecommunications*. Cambridge: The MIT Press.
- Guasch, J. Luis, Jean-Jacques Laffont, and Stephane Straub.** 2003. "Renegotiation of Concession Contracts in Latin America." The World Bank, Policy Research Working Paper WPS3011.
- Kwerel, Evan R., and Gregory L. Rosston.** 2000. "An Insiders' View of FCC Spectrum Auctions." *Journal of Regulatory Economics*, 17(3): 253-289.

Exhibit 1. Specifications for Spectrum Licenses

License	A	B	C	D	E
Spectrum	1850 MHz	1870 MHz	1900 MHz	1915 MHz	1930 MHz
Bandwidth	15 MHz	20 MHz	10 MHz	10 MHz	10 MHz
Current Users	One	None	Two	None	One