



## Spectrum (A)

Many of the important transactions businesses enter into involve *synergies*. Hiring a department, putting together mergers, and network creation of just about any kind all involve putting together an entity with value greater than the sum of its parts. But trading on synergies, in a competitive market, entails a kind of market risk that can have a big influence on success or failure. To illustrate the issues and remedies, we will simulate the telecommunication's market for bandwidth licenses.

This write-up contains public information, available to all traders. Private information, available to only your team, will be posted to your team in a separate Excel file on the Angel web site.

### *Spectrum Background*

Since its inception in 1934, the Federal Communications Commission (FCC) has been entrusted with the regulation of the radio spectrum, for both interstate and international broadcasting. The FCC's major powers include issuing and revoking licenses and well as monitoring the content of public broadcasting programs.

An FCC license is required to operate radio stations, television channels and cell phone companies, and so is of paramount importance to the operators of these entities. A license entitles the owner to exclusive access to a particular radio wavelength; that is, to emit electromagnetic waves at a particular frequency. A license typically lasts from 6 to 15 years, after which it needs to be renewed.

At first, the FCC gave away licenses, but later began to sell them.

### *Synergies and the Exposure Problem*

The transaction of these licenses is risky due to the complementarities that tend to exist between them. Specifically, the value of a license often depends on what other licenses the operator owns. A cell phone license for New York, for example, is typically more valuable if the operator also owns the adjacent licenses in Philadelphia and Washington. These kinds of synergies can open the purchaser up the *exposure problem*, the risk incurred in buying a particular license now while the future acquisition of complementary licenses is uncertain. Cramton (2002) illustrates the exposure problem in the context of two people bidding in an auction for parking space:

---

*This note was prepared as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation. Prepared by Prof. Gary Bolton and Prof. Elena Katok of Smeal, and Victoria Korchagin, Penn State Class of 2008.*

“One bidder with a car and a trailer requires both spaces: she values two spots together at \$100 and a single spot is worth nothing; the spots are perfect complements. The second bidder has a car, but no trailer. Either spot is worth \$75...the spots are perfect substitutes. Note that the efficient outcome is for the first bidder to get both spots for a social gain of \$100, rather than \$75 if the second bidder gets a spot.

“Yet any attempt by the first bidder to win the spaces is foolhardy. The first bidder would have to pay at least \$150 for the spaces, since the second bidder will bid up to \$75 for either one. Alternatively, if the first bidder drops out early, she will “win” one license, losing an amount equal to her highest bid. The only equilibrium is for the second bidder to win a single spot by placing the minimum bid.”

### *Sales of Licenses through Lottery and the Coase Theorem*

Operators pay to own the rights to operate in a particular area. Television channels were regulated first and divided into channels by frequency. Each frequency carries several hundred channels nationwide. The commission began to regulate radio in the 1960s, just as the FM band was emerging. The country was divided into zones, each with certain bandwidth restrictions and certain classifications.

When the FCC began to sell licenses, it did so through a lottery system. Licenses were simply awarded randomly, chosen from a list of qualified applicants willing to pay the fee. Sorting out license complementarity issues was left to the secondary market where licenses trade privately.

This procedure is not entirely arbitrary. There is a famous proposition known as the *Coase Theorem* (after Ronald Coase, 1991 Nobel Prize winner in economics), implying that this sort of property assignment can be socially efficient. As it happens, Coase stated his theorem in 1959 as a proposal for the regulation of radio frequencies. At the time, the major issue was the potential for adjacent stations to interfere with one another by broadcasting on the same frequency band. Coase argued that adjacent radio stations (initially) interfering with each other was really not a problem. So long as there were clear, tradable property rights, the station that put the highest value of the broadcast would have an incentive to pay the other station not to interfere. A mutually advantageous deal will solve the problem, at least so long as the deal’s transaction costs are not prohibitively high. The upshot is that, so long as there are no impediments to trade, the initial allocation of property rights does not matter in the sense that the market will ensure that these rights eventually end up in the hands of those who can put them to the most profitable use.

### *The Spectrum Market Simulation*

The simulation you will take part in is based on the FCC distribution procedures described above (the procedures changed in the 1990’s, something we will discuss after the simulation).

In the simulation, you are planning on starting a cellular phone service company, providing the radio frequencies necessary to carry on a wireless conversation. You, along with the other service providers have been allocated licenses through the FCC lottery system. Many of the

providers are dissatisfied, and were not allotted exactly the areas they wanted. There is going to be a secondary market for licenses, with a total of 20 participating providers.

For this purpose, the country has been divided into 10 regions, A through J, each region with 8 licenses, labeled A1, A2, A8, etc, all the way through J8. The lottery system randomly allocated four to each provider, for a total of 80 licenses. In addition, each provider has been endowed with \$1000 in cash.

Your team's private information, available only to you/your team, includes your team id and password to access the electronic trading platform, and your personal license valuations for each region and combinations of licenses. *Different providers can have different values.* The file also include an item that will be public information: your team's initial endowment of firms.

The objective of the game is to trade to maximize the value of your portfolio, where the portfolio value is the sum total of your companies' dollar value plus your cash holdings.

### *Logistics*

Licenses are traded either through individual negotiation or through auction. Traders may set up and run their own auctions or can use the auction feature on the Spectrum website. Those who run their own auctions, can set their own rules. Website auctions run for a fixed time, are first-price sealed bid, and must be initiated by a seller. Once initiated, the auction lasts 5 minutes. The seller may announce a minimum (reserve) price for the license. To announce an auction, the seller goes to the START AUCTION page on the Spectrum website and records the necessary information (i.e., license for sale, and minimum price if any). A bidder submits a bid on the website by selecting the auction (Click on Bid >>), and then submitting the bid on the form that appears in a new window. A team can submit no more than one bid per auction. Note: The website will not accept any new auctions if there is less than 5 minutes left in the market.

**Important: Closing a deal requires specifying the buyer, seller, and sale price to the Spectrum website, which will update the portfolios and cash balances of both teams – until this is done, the sale is not official.** A deal is completed by the selling team logging in to the Spectrum website and going to the COMPLETE SELL TRANSACTION page. The buying team inputs their ID and password, the correct company is selected and the price is specified. The Submit button completes the deal. Deals made through the website auction feature will update automatically. Deficit spending is not permitted. Non-cash deals, swaps, and bundled sales (selling two licenses for a single price) are not permitted; they must be broken out as a series of single license transactions.

### *Preparation*

Prior to the market, get together with your team to discuss strategy. Be sure you understand the rules; you will have an opportunity to ask questions prior to the opening of trade. Tour the Spectrum trading platform at <http://lems.smeal.psu.edu/fcc/>. You will need the log-in information on your private information Excel sheet to access it. Browse the site's trading features, and your team's own private trading page, and come prepared to trade!

## *References*

Coase, Ronald H., "The Problem of Social Cost," *Journal of Law & Economics*, 1960, 3, p. 1-23.

Cramton, Peter, "Spectrum Auctions," *Handbook of Telecommunication Economics Volume 1*, M. Cave, S. Majumdar and I. Vogelsang (eds.), 2002, 605-639.