
Voluntary Relocation of Spectrum Incumbents

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(based on work with Peter Cramton)
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The Problem

- ◆ Engineering efficient band plans...
 - group low power uses together
 - create contiguous bands
 - provide consistent bands across geography
- ◆ Right to continue in a particular band/use
 - Scattered incumbents may block transition to more efficient band plans
 - Right creates “local monopoly” power
 - Right avoids relocation costs
 - Not a property right—efficient allocation is problematic
- ◆ Question: How to encourage voluntary relocation?

Auction Solutions?

- ◆ Goal: outcomes in the “core”
 - Efficient
 - Reasonable prices
- ◆ Incentive problems
 - Threshold problem (package auction):
 - » Bidder for item A has value a
 - » Bidder for item B has value b
 - » Bidder for package AB has value $c < a+b$
 - » All values (or just a and b) unknown.
 - Bargaining problem (package exchange):
 - » Seller has cost c .
 - » Buyer has value $b > c$.
 - » Both values unknown.
- ◆ Non-core outcomes appear likely

Should we be “concerned”?

- ◆ “The systematic results thus far derived from the body of laboratory-controlled studies of the above [package auction] mechanism are:

1. There is little evidence that the threshold problem is of great concern....”

David Porter, Stephen Rassenti, Anil Roopnarine, Vernon Smith (2003), “Combinatorial Auction Design,” *Proceedings of the National Academy of Sciences*

- ◆ Is this conclusion convincing?
 - No systematic testing of related hypotheses
 - Limited data availability
 - Experimental conditions may suppress threshold effects
 - External validity? Generalizability?

Role of Substitutes

◆ If and only if items are substitutes...

- Market clearing prices always exist*
- Vickrey outcomes always in the core**
- Ascending proxy auctions have “dominant strategies”**

*Kelso-Crawford (1982), Gul-Stacchetti (1999), Milgrom (2000)

**Ausubel-Milgrom (2002)

◆ Local monopoly power in spectrum because...

- geography and spectrum adjacency do matter
- so licenses are not good substitutes

Spectrum Exchange Example

- ◆ Incumbent licensees on one dimension



- ◆ Bidder 1 seeks three adjacent bands
- ◆ Theoretical inefficiency
 - Bargaining/threshold issue promotes inefficiency
 - Problem worse for higher dimensions
 - Problem worse for more adjacent bands

Example, continued

- ◆ Incumbent licensees on one dimension



- ◆ Bidder 1 seeks three adjacent bands

- ◆ *If incumbents agree to relocate...*

- ◆ Theoretical analysis

- Rights are more often substitutes
- Overlay license rents are low or zero
- Transition is successful, efficient
- Local monopoly power eliminated
- **Incumbents will resist!**

Creating Substitutes

- ◆ Q: Can we make licenses substitutes?
- ◆ A: Yes, if incumbents can be relocated.
- ◆ Q: How to encourage voluntary relocation by auction/exchange sellers?
- ◆ A: Use a carrot for sellers who agree, such as
 - Relocation costs paid
 - Allow flexible use for licenses **offered** in the auction
 - Allow flexible use for licenses **sold** in the auction
 - Bidding credit for spectrum purchases based on licenses offered/sold.

A Challenge to the Assumptions

Silicon Valley Engineers' View

- ◆ New technologies eliminate scarcity
 - Smart, digital radios
 - Low-powered signals
 - Focused radio beams
- ◆ Spectrum management
 - Current “property rights” regime hasn’t worked
 - Changing technologies demand flexible management
 - Spectrum commons approach should be employed
- ◆ Commons approach: FCC...
 - sets standards
 - » ensure technically efficient use
 - » mandate good etiquette
 - mandates universal access rules

Advocates' Comparison

Managed commons approach

1. Cost of negotiating over reallocations avoided
2. Spectrum scarcity can be entirely avoided
3. Universal access rules can be mandated
4. Economies of scale in a single spectrum pool
5. New technologies can be mandated for efficient spectrum use
6. Coordination problems are avoided

Property rights w/ flexible use

1. Rights can be reallocated as needed (Coase Theorem)
2. Avoiding all spectrum scarcity is too costly
3. Universal access rules can be mandated
4. Divided spectrum allows helpful variety of standards
5. New technologies are adopted only when & where economical
6. Uniform rules don't respect differing compliance costs

End