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Interlicense Competition **SPECTRUM DEREGULATION WITHOUT CONFISCATION OR GIVEAWAYS**

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Abstract

The right to use US radio frequency spectrum is extremely valuable. Unlike most property rights, licenses to use radio spectrum are granted for limited terms and carry significant restrictions on how the radio spectrum is used. Economic efficiency suggests that existing license rights should be expanded to give users the flexibility to redeploy spectrum to its most valuable use and to trade licenses or unused capacity on secondary markets. Distributing these expanded rights to use radio spectrum raises questions of both efficiency and equity. This paper proposes an auction mechanism for distributing additional usage rights: interlicense competition. Derived from an auction procedure used by the Interior Department for the auction of mining leases, this mechanism grants license relaxation rights using competition, while ensuring that the government still obtains the fair value of the licenses it is granting. Interlicense competition overcomes the fact that the holders of existing usage rights have a strong competitive advantage over any challengers. This auction mechanism could be a useful addition to the arsenal of tools available to the FCC. Its availability means that it is not necessary to give away spectrum to incumbents to gain the advantages of fully flexible license rights.

1. Introduction

In the United States, the radio spectrum is legally the property of the public, but with varying degrees of private use rights. The radio spectrum is extremely valuable—many times more valuable than all of the gold in Fort Knox.¹ For over three quarters of a century, the government has been making policy with the aim of having this valuable asset used in the public interest—a nebulous standard that has been subject to many different interpretations.² At present, some frequencies are reserved for government uses—defense, air traffic control, public safety, etc.—and some are licensed to companies for a variety of particular uses such as broadcasting and fixed and mobile communications. Almost all the valuable bands of spectrum—those that propagate well through walls, trees, and weather— have already been assigned for some use.³

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The current system of spectrum management is based on a command-and-control framework. The Federal Communications Commission (FCC) manages the allocation of private and state and local government uses of spectrum, while the National Telecommunications and Information Administration (NTIA) coordinates the federal uses of spectrum. For non-federal uses, traditionally the FCC allocates blocks of spectrum to types of uses, such as broadcasting or satellite, creates channel assignments and then assigns license rights to users. Licenses often specify where, when and how the licensee may use the radio spectrum. For instance, a typical television license will specify a transmitter tower location, height, power levels, channel assignment and broadcast technology.

Licenses traditionally were distributed on a first come basis. When more than one applicant wanted a particular license, the FCC was forced to choose among competing applicants. For most of its history it used comparative hearings, commonly referred to as beauty contests. This became an expensive and inefficient procedure and was replaced with lotteries in the 1980s. Beginning in 1994, the FCC began conducting auctions to assign licenses that had mutually exclusive applications. The FCC has pioneered innovative auction formats to assign rights to use radio spectrum. The assignments to date have generally been for bands of spectrum where either there were no significant incumbents or there were clear rules for removing the incumbents.

2. Distributing Expanded License Rights

Currently, the FCC allocates spectrum on a licensed or unlicensed basis. Examples of licensed services are mobile telephone, broadcasting, and direct broadcast satellite. The licensee pays the government or promises to serve the public interest in return for use of the public airwaves. Examples of license-exempt services are cordless phones, garage door openers, Wi-Fi devices, and other consumer devices. On license-exempt bands, consumers share the spectrum without paying a fee to either the government or a licensee. This paper will not address when access to the spectrum should be under a licensed or unlicensed regime. Instead, we take the decision to expand the user rights in a currently licensed band of spectrum as given and look to how those expanded, and hence more valuable, rights are distributed to private entities. There is a general consensus at the FCC and among policy experts that the commercial use of spectrum should be largely deregulated, giving users far greater flexibility to determine the service provided on a band, or even to sell or sublease access to other firms through secondary market transactions.

Many interesting questions are raised in trying to define the scope and nature of the rights that should be attached to licensed radio spectrum. At one extreme are fee simple property rights and at the other extreme are time-limited, royalty-based rights leases. These are important questions, but this paper is agnostic with respect to them. It is concerned with the method of distributing expanded rights, however they are defined.

There are at least two problems inherent in distributing expanded license rights in spectrum. First, there is a desire (or, at least, a political imperative) to respect the rights

granted to current licensees, including the presumption a license will be renewed, even when those licensees received their licenses free, for a specific purpose, and for a limited time. Indeed, the Communications Act stipulates that licenses are temporary and confer no residual ownership interests. Second, both fairness and efficiency require that the government receive most of the value of the liberalization of the licenses. Since the right to use the spectrum for commercial purposes is worth hundreds of billions of dollars, the fairness aspect of a spectrum giveaway probably requires little comment beyond Senator McCain's observation that "They used to rob trains in the Old West. Now we rob spectrum." However, the efficiency argument is more subtle, and it is critical since the case for "privatizing" the spectrum is based upon efficiency.

The essence of the efficiency argument against a giveaway is that if the government fails to get full value for assets it gives away, the money it does not receive must be raised with taxes.⁴ There is a substantial economic literature documenting the marginal inefficiencies associated with raising money from income taxes.⁵ A conservative estimate is that for every three dollars in federal revenue forgone (requiring, therefore, additional taxes to be raised) there is an additional dollar of lost productivity. **Consequently, the added cost of the deadweight loss of raising government revenues—or increasing the federal deficit—to compensate for lost spectrum revenue should be recognized as part of the price paid by the public when spectrum rights are given away.**

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Proposals exist to distribute spectrum relaxation rights. In the summer of 2002, the FCC established a Spectrum Policy Task Force (SPTF) with the mission to "provide specific recommendations to the Commission for ways in which to evolve the current 'command and control' approach to spectrum policy...."⁶ In the end, the SPTF recommends that the Commission find a modest 100 MHz of spectrum below 5 GHz to transition from the current command and control regime to a market-managed regime based on flexible spectrum rights.⁷

The SPTF does not recommend a specific process for distributing the expanded spectrum use rights, but two of the Task Force's members do. FCC senior economist Evan Kwerel and FCC recently retired senior engineer John Williams propose an auction to distribute rapidly significant amounts of spectrum relaxation rights, commonly referred to as the 'Big Bang' auction proposal. Their proposal entices incumbents to put their existing spectrum license rights into the auction so that bidders will be able to bid on the full set of rights for a specific band of spectrum. Incumbent license holders are given three incentives to participate: first, they receive 100% of the auction receipts if their band is sold (or a prorated portion if the band is shared or combined with FCC reserve spectrum); second, if the band goes unsold, the licensee gets the expanded rights for free; and third,

the licensees get the right to match any competitive bid and thereby “buy-back,” at zero cost, the expanded rights (thus discouraging others from competing for the rights). They propose auctioning bands totaling 438 MHz of spectrum under 3GHz.⁸ This ambitious auction proposal will likely distribute expanded use rights to incumbents for free or at far below their value. This is consistent with Kwerel and Williams’ approach to spectrum management that focuses solely on the efficiency gains associated with distributing the expanded and valuable license rights to the largest amount of spectrum possible as soon as possible.

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The likely low revenue outcome of the Big Bang proposal is driven by the presumed ability of incumbents to hold up the use of spectrum by new users. Hold up occurs when the incumbent can demand a disproportionate share of the benefits from the new, higher valued uses of a band of spectrum. By scaring away other bidders, the incumbent becomes the likely only bidder in many bands. It is a bit like trying to sell a valuable block of downtown real estate when someone has the right to have a lemonade stand on it. Who will offer to pay anything near its real value when the owner of the rights to the lemonade stand can block any potential use of the property. (This example is not far fetched. The right to broadcast television on a UHF station in a major city where almost everyone who watches the station gets their signal over cable is probably worth a few percent of what the spectrum would be worth for mobile communications.⁹) Normally, if such downtown real estate were put up for competitive sale, the owner of the lemonade stand rights or someone in partnership with him would be the only serious bidder. With only one bidder, market forces could not be relied upon to set a price that comes anywhere close to the value of what is being sold. The purpose of this paper is to propose a way to overcome this difficulty.

3. A Current Example: The ITFS/MDS Band¹⁰

In April of 2003, the FCC issued a Notice of Proposed Rule Making designed to facilitate the flexible provision of fixed and mobile broadband services, as well as educational and other advanced wireless services, in the 2500-2690 MHz bands. Currently the largest portion of this band (124 MHz) is assigned, at no cost, to universities and other nonprofit educational institutions in the 50 states for the purpose of providing Instructional Television Fixed Service (ITFS), primarily for the purpose of distance learning. Major universities and the Catholic Television Network are among the primary users. The other 66 MHz are assigned to private multipoint distribution services (MDS).

The entire ITFS/MDS band is divided into 33 channels, since the original purpose of the allocation was to enable both educational and commercial point-to-multipoint video broadcasting. The channels (and license rights) are 6 MHz wide. A comparable digital video transmission today would require only 1 MHz of spectrum or less, which is one of the reasons the band’s channel allocation is inefficient. Another reason is that

educational institutions use only a fraction of the band's spectrum capacity – and the commercial wireless firms willing to pay for access to the band would need the flexibility to offer low-power fixed or mobile services, which is currently the most profitable use of the band but is not feasible as currently allocated. The non-profit educational users (ITFS) are required to use only 5% of channel capacity for non-profit education and can lease out unused channels to MDS users, which they commonly do for the stated purpose of acquiring access to costly private transmission facilities, technical support and program funding. Many educational licensees formed public-private partnerships to lease out spectrum capacity.

The Commission's NPRM proposes a substantial restructuring of the ITFS/MDS band from one of interleaved and inefficient channelization, into a band plan consisting of three major contiguous bands with a great deal of additional flexibility to provide new services or to sell or sublease license rights on secondary markets. Current licensees would be granted value-increasing flexibility rights not explicitly assigned in two ways: first, through conversion from site-based to geographic-area licenses; and second, through the removal of educational service obligations that would eliminate duties on the public-service channels and allow largely commercial services to expand throughout the band. Finally, as an incentive to reallocate incumbents to the new band plan, "two-sided" restructuring auctions have been proposed in which incumbents would be allowed to retain whatever 'inducements' remain above their costs of replacing equipment.

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Under the proposed reallocation of the band, high-power ITFS users will be pushed into spectrum roughly 60% smaller their current allowance, while MDS users will receive complete service flexibility and the opportunity to double their current allocation. With the conversion of licenses to geographic service areas and with no further educational mandate, full flexibility to provide any sort of service whatsoever would be conferred on the final license holder with zero direct payback to the public. Current commercial licenses in the band, like the coal tract owners described in the next section, will have the greatest incentive and advantage in acquiring these new, more valuable license rights at auction. And although the notice and comment period on the rule has just begun, if the FCC adopts a "two-sided" auction, both the commercial and educational licensees would retain revenue that otherwise would flow into the public treasury.

The ITFS/MDS proposal is by no means an isolated example. Radio broadcasters, TV broadcasters, mobile telephone companies, and others in recent years have all won rights worth billions of dollars without paying any public compensation. But because this proceeding is now under active consideration at the FCC, it is especially timely.

4. An Alternative: Interlicense Competition

We describe an auction procedure that can be used to sell relaxation rights that liberalize the use of spectrum while obtaining for the government the fair value of the licenses it is granting. The heart of the proposal is an adaptation of a procedure suggested by C. Bart McGuire and used in the early 1980s by the U.S Department of the Interior to auction coal rights to Federal coal tracts where the owners of adjacent coal deposits were the only logical bidders.¹¹ In the context of coal, the approach was called “intertract competition.” It made the bidders for different coal tracts compete with each other. This approach was authorized by Congress and evaluated favorably by the “Linowes Commission,”¹² established by Congress to investigate a scandal that shut down Interior Department coal leasing in the early 1980’s.

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The proposal also draws on two other ideas from the auction literature. One is the idea of treating a constraint on the total amount to be sold as “soft.” This idea dates back to discussions of “PURPA auctions” for electricity supply contracts.¹³ The combinatorial bid version of the proposal also draws on the idea of rejecting bids when their “inflexibility” would constrain the solution to the problem of selecting the revenue-maximizing set of bids. This idea is used in the auction of natural gas pipeline capacity by the Natural Gas Company of America, and was proposed by them.

Under this proposal, no licensee’s rights will be damaged or limited in any way. However, under this proposal, no licensee or other party will get spectrum relaxation rights without competition. In particular, current licensees for a service that greatly under utilizes spectrum will have to compete with others to get their license restrictions eased even though they may be the only bidder for the particular rights that complement theirs. **It is not necessary to give away spectrum rights in order to have the advantages of private ownership incentives.**¹⁴

The next section of this paper presents the interlicense competition proposal, first in simplified form and then in a more complicated form in which bidders can make offers on relaxation rights on combinations of licenses. This is followed by a discussion of the proposal, of implementation issues, and of some specific concerns in spectrum management policy such as public interest obligations.

5. A Simplified Proposal for Interlicense Competition

Here is a simple version of the interlicense competition proposal to expand spectrum license rights without either giving them away for much less than their value or forcing the holders of existing rights to release them.

Under this simplified proposal, Congress will authorize the FCC to announce an annual or perhaps biannual series of auctions of “overlay” spectrum rights. Each auction will relax the current regulatory constraints on a given amount of spectrum (measured in units of bandwidth times the population area covered, i.e., in MHz-Pops¹⁵) for essentially unrestricted use subject to responsibility for noninterference with licenses for other frequencies and other geographic areas as well as any existing license on the spectrum. However, the amount to be sold in a single sale will be a relatively small fraction, perhaps 10% to 20%, of the amount upon which bids will be accepted. While for national security, public safety, or other special purposes some spectrum may be excluded from bidding in these sales, relaxation rights for most privately licensed spectrum will be eligible for sale and sold if the offer for it is high enough. Any currently licensed spectrum offered will be subject to the rights of the current spectrum license holder.

The current license holder may bid to relax the restriction on her license. Others may also bid for these relaxation rights, although other bidders may well be at a disadvantage relative the current rights holder. (Essentially unrestricted rights can be offered for unlicensed spectrum.) The auction will be a sealed-bid, market-clearing-price auction. In this simple version of the auction, there will be no combinatorial bids and spectrum with the highest bids per MHz-Pop will be sold up to the cut off limit on MHz-Pops for the sale. (The important consequence of this is that a license holder wishing to relax the constraints on a license will have to compete for the right to do so with holders of other licenses who also wish to relax the constraints on their licenses.)

In this simple version of the auction, in order to select the winning bids the FCC will first rank order the bids with respect to the amount offered per MHz-Pop. Starting with the highest ranked bid, the FCC will award eligible bids that do not conflict with previously accepted bids until it reaches a bid that would put the total sold over the limit set in advance of the auction for MHz-Pops. This bid is the marginal bid and will set the price per MHz-Pop for all accepted bids (whether it itself is accepted or not). If accepting the marginal bid would make the total MHz-Pops sold exceed the announced target by less than a pre-announced tolerance percentage, the bid will be accepted. If accepting the bid would result in exceeding this tolerance limit, then the FCC will reject the bid. All bids offering a price per MHz-pop less than the marginal bid will be rejected. If the bid acceptance process ends without reaching the target number of MHz-Pops, then all bids that have not been rejected will be accepted and the price per MHz-Pop will be the minimum allowable bid.

Two easy-to-show theoretical results are worth noting. First, if the tolerance limit exceeds the size in MHz-Pops of the largest license, then the auction will always end with the acceptance of the marginal bid. Second, whenever the auction ends with the acceptance of the marginal bid, the total value expressed in the accepted bids is the maximum possible for the number of MHz-Pops sold.

Interlicense Competition: More Design Details

In auction design, the devil is in the details. It is vital that a number of procedural details be set up correctly. Substantial deposits should be required of bidders, and there should be prompt payment by winners and prompt awards to them upon completion of the auction. If citizenship or other qualifications are required, bidders should be required to assert under oath at the time the deposit is made that they meet them. All eligibility challenges except ones connected with criminal prosecutions for perjury should be limited to the period before the auction.¹⁶

Immediately after the auction, the FCC should return deposits on unsuccessful bids. Successful bidders will pay the remainder of the price of what they have won, and licenses will be awarded to them. If they fail to pay, they will be in default, should lose their deposits and get no rights, bankruptcy laws notwithstanding.

Before each periodic auction, the FCC will announce to potential bidders the geographic units (and their populations) that will be used and any frequencies that are not available. If some frequencies are available in some geographic regions but not others, this too will be announced. For simplicity, we will call the units the FCC announces “licenses.” All frequencies not explicitly excluded will be available subject to the specific rights of existing licensees. The FCC will also announce the tentative target total number of MHz-Pops to be sold. Bidders should not be surprised by the announcement since a long-term plan for making frequencies available will have been adopted.

The FCC will also announce the deposit required from bidders per MHz-Pop of bidding eligibility. The deposit will be a substantial fraction of the anticipated price per MHz-Pop in the sale. It may also serve as the minimum bid per MHz-Pop, which should also be a substantial fraction of the anticipated price. In order to avoid a noncompetitive auction, after the deposits are received the FCC will, if necessary, announce a reduced total of MHz-Pops to be sold so that the amount to be sold is no more than some pre-announced fraction, say one-fourth, of the total eligibility.

Lower band and upper band relaxation rights should be sold in separate auctions, because not all MHz-Pops are the same. For example, lower frequencies that are suitable for mobile communications are more valuable than the upper frequencies (above 3 GHz) that do not readily propagate through walls, foliage and precipitation. It is important for the auction that bids be on the same basis so that they can be meaningfully compared. Further refinements in the \$/MHz-Pops based on the frequency of the band in the bid *may* be considered useful.

Note that each of the periodic auctions can be treated as a one-time, sealed-bid auction. Hence, there is no need to restrict the bids to round numbers to prevent signaling. Since the bidders have the possibility and incentive to use lots of significant digits in their bids, ties should be exceedingly rare. If ties become common, collusion should be suspected. To discourage tacit collusion, bids at the exact same price should be treated as a single bid. If accepting this “bid” would result in too much spectrum being sold, all of “it” should be rejected.

An Example

Before going further, it may be useful to work through a small example. Table 1 gives the highest nine of a large set of bids. For convenience, the bids have been numbered in decreasing order of bid amount

Table 1. A Set of Bids

Bid #	\$/MHz-Pop	License #	MHz-Pops ($\times 10^6$)
1	6.0121	4321	60.2
2	5.8327	5432	43.5
3	5.7511	4321	60.2
4	5.6330	6543	12.7
5	5.5112	7654	44.0
6	5.5081	8765	32.6
7	5.0423	9876	25.8
8	4.8899	1234	10.4
9	4.8001	2345	10.9
etc.			

Suppose that the government has announced that it will sell relaxation rights for 200 ($\times 10^6$) MHz-Pops with a tolerance of 5%. In this case, it will accept bid 1 and bid 2. It will reject bid 3 because it has already sold the relaxation rights to license # 4321 to bid 1. It will then accept bids 4, 5, and 6. This brings the total MHz-Pops of accepted bids to 183.0 ($\times 10^6$). Bid 7, if accepted, would bring the cumulative number of MHz-Pops of accepted bids to 208.8 ($\times 10^6$). Since this is within 5% of the target of 200 ($\times 10^6$), the bid will be accepted and its price will set the price of all accepted bids at \$5.0423 per MHz-Pop. If the tolerance were only 2.5%, bid 7 would cover too many MHz-Pops to accept. It would be rejected, but it would still set the price for all accepted bids. Bids 8 and 9 would not be accepted even though accepting bid 8 would leave the total MHz-Pops sold below 200 ($\times 10^6$) MHz-Pops and accepting bids 8 and 9 would leave the total at 203.3 ($\times 10^6$) MHz-Pops, below 102.5% of that amount.

In this example, accepting bid 8 or bids 8 and 9 after rejecting bid 7 would create two anomalies. First, a bid has been rejected that would have offered a higher unit price than an accepted bid. Second, a bid below the demand curve would have been allowed to set the price. This second anomaly could be quite large, if for example, there was a very low bid for relaxation rights on a license with just 1 ($\times 10^6$) MHz-Pops. It could be accepted in addition to bids 8 and 9 and still leave the total of accepted bids below 205 ($\times 10^6$) MHz-Pops.

6. Interlicense Competition with Combinatorial Bids

It is quite possible that the relaxation rights on an FCC license are worth more if the relaxation rights on other licenses are also obtained. This effect could be mild or it could be critical as when a proposed communication service would absolutely require the relaxation rights of many existing licenses. In addition, it is possible that relaxation

rights on alternative licenses would allow a proposed service so that a bidder would like to offer bids in the alternative. Finally, it is possible that bidders are capital limited and would like to limit their total expenditures in an auction. Thus, it is potentially quite useful to allow bidders to bid for combinations of relaxation rights rather than just for individual rights and to place constraints on their bids. However, allowing bids on combinations and such constraints makes selecting the winning bids more difficult. Furthermore, it is potentially possible that allowing such restrictions on bids would allow bidders to gain an unfair advantage by winning a license at a lower price than another bidder is willing to pay simply by being willfully inflexible.¹⁷ Auction design choices must deal with these possibilities.

The design of an auction with combinatorial bids is considerably more complex than a single bid auction. These complexities have been discussed elsewhere in the auction literature.¹⁸ For a discussion of a combinatorial bid system applied to an auction with interlicense competition, see our January, 2003 comments filed on the FCC Spectrum Policy Task Force recommendations (Rothkopf and Bazelon, 2003).

7. Policy Discussion

Radio spectrum is a highly valuable public asset. There are strong arguments that U.S. spectrum is badly under used and over restricted and that a licensing system based upon expanded and flexible use rights would work better. While there is a legitimate need to protect temporarily non-licensees who have invested in equipment, the overriding picture is one of misallocation and of the use of administrative procedures to block competition. The proposal in this paper would gradually make spectrum available on a property-rights-like basis. We believe its gradual nature is an advantage. It will take a while for capital markets and physical ones to adapt, and non-licensee purchasers of equipment will have a chance for their equipment to be used. **The use of competition to determine which spectrum is freed up first will tend to assure that the spectrum first released from usage restrictions goes to meet the most pressing unmet needs.**

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One interesting perspective on spectrum rights comes from natural resource management. There is a long tradition in U.S. natural resource management of preventing speculative holding of publicly owned resources. This is often done through diligence requirements. Of course, one important difference between land or minerals and radio spectrum is that the lost value from unused spectrum is lost forever—it is a nondepletable natural resource. Nevertheless, there is precedent for the government being the custodian of a natural resource and holding on to ownership (in this case, the relaxation rights to spectrum) until the resource can be used productively.

In choosing an auction mechanism, the government faces two competing goals. On the one hand, the sooner a fuller set of spectrum rights are in private hands, the sooner they can be put to use (within the constraints of the ability of that spectrum to be used productively) with the concurrent increase in consumer welfare. On the other hand, the government wants to receive compensation for the public in return for distributing the valuable relaxation rights to the spectrum. Unfortunately, these two goals are somewhat in conflict. That is, increasing the supply of relaxation rights decreases per unit prices the government will receive. Ideally, this trade-off is solved by transferring the relaxation rights to the private sector at a pace that equates the marginal cost to society in lost service from holding back a little more of the relaxation rights with the marginal cost to society of lost government revenues from slightly increasing the pace that the relaxation rights are distributed.

The above trade-off illuminates an essential difference between the approach taken in this paper and the one proposed by Kwerel and Williams. Their approach does not consider the marginal cost of government revenues. Either they think this cost is not relevant for the analysis of spectrum license rights, or they believe that the optimal trade-off between revenues and the speed of distribution of expanded license rights falls heavily on the side of the distribution of those rights. In either case, we disagree. As noted earlier, the marginal cost of a lost dollar of governmental revenue is approximately \$0.33. This implies that the measured inefficiencies in the use of spectrum from slowing the pace of distribution of relaxation rights can get as high as 33 percent before they outweigh the revenue enhancing effects of that slower pace of spectrum rights distribution.

The auction is not “optimal,” but it is reasonable, and in this rich context, what is optimal is not known. It should prove to be workable for fairly large auctions. It should allow bidders to represent important synergies. It should give good incentive signals to bidders whenever the chance that a given bid will be the marginal one is small. It should be relatively resistant to collusion. It should work particularly well in a situation in which on each license one party already controls some rights and thus is the only party bidding for relaxation rights on it.

In general, the process should efficiently pick out to sell first the most valuable rights. No administrative determination will be needed. Nonetheless, critical spectrum that should not be offered can be protected.

The auction allows combinatorial bidding. Nonetheless, computational problems are avoided by placing mild constraints on the bidding.

The proposed process is independent of the application of the funds it generates. If desired, some of the funds can be used to compensate for dropped public interest obligations. Moreover, the interlicense process is also neutral with respect to the duration of rights auctioned. Congress could determine that the auctioned rights are permanent, or could determine that a spectrum user fee (or lease fee) should attach after the initial license term.

In the past, the FCC has received less for some licenses than it might have because independent companies formed coalitions before entering the auction. This happened to an extreme extent in some European spectrum sales. Hence, it is tempting to suggest that legislation enabling the auctions should protect competitiveness by restricting joint bidding, not just by coalitions formed after bid deposits have been made, but also by joint ventures formed after the legislation is introduced. However, some new uses of spectrum may well require rights held by different parties. In such cases, coalition formation is natural and can be helpful. The solution is for the FCC to limit the amount of spectrum to be sold so that there is a high “eligibility ratio,”-- i.e., there are four or more serious bidders for each license that is to be sold. This should ensure that there is serious competition even in the face of coalitions and discourage coalitions that would only pay off by reducing competition in order to lower prices.

In summary, with interlicense competition no licensee’s rights will be damaged or limited in any way, but no licensee or other party will get spectrum rights without serious competition and some payment back to the public. In particular, those with rights for a use that greatly under uses spectrum will have to compete with others to get their license restrictions eased even though they may be the only bidder for the particular rights that compliment theirs. **It is inefficient and unnecessary to give away spectrum rights in order to have the advantages of private ownership incentives completely flexible license rights.**

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ENDNOTES

¹ See J.H. Snider, *et al.*, “The Citizen’s Guide to the Airwaves,” The New America Foundation, Washington, DC, July, 2003.

² For a detailed discussion of U.S. spectrum management, see Congressional Budget Office, *Where Do We Go From Here? The FCC Auctions and the Future of Radio Spectrum Management*, Washington, D.C.: U.S. Government Printing Office, April 1997.

³ For details on the current spectrum allocations, see Bennet Kobb, *Wireless Spectrum Finder: Telecommunication, Government and Scientific Radio Frequency Allocations in the U.S. 30 MHz to 3000 Ghz*, (New York: McGraw-Hill, 2001).

⁴ See Michael H. Rothkopf and Ronald M. Harstad, “Reconciling Efficiency Arguments in Taxation and Public Sector Resource Leasing,” RUTCOR Research Report #66-90 and School of Business Working Paper No. 155, Rutgers University, New Brunswick, NJ. 1990.

⁵ While there may be unused opportunities to tax pollution or other externalities, these are likely to be relatively small, and the marginal source of tax revenue is the income tax. For details see Charles Ballard *et al.*, “General Equilibrium Computations of the Marginal Welfare Costs of Taxes in the United States,” *American Economic Review* 75, (1985): 128-138. Also see Don Fullerton, “If Labor is Inelastic, Are Taxes Still Distorting?” Working Paper, University of Virginia, 1998. Also see Charles Stuart, “Welfare Costs Per Additional Tax Dollar in the United States,” *Am. Econ. Rev.* 74 (1984): 352-362.

⁶ See FCC Spectrum Policy Task Force, “SPTF Report,” ET Docket No. 02-135, Nov., 2002, p.1.

⁷ See “SPTF Report,” p.51.

⁸ See Evan R. Kwerel and John R. Williams, “A Proposal for Rapid Transition to Market Allocation of Spectrum,” OPP Working Paper No. 38, Federal Communications Commission, Washington, DC, 2002.

⁹ See Evan R. Kwerel and John R. Williams, “Changing Channels: Voluntary Reallocation of Spectrum,” OPP Working Paper No. 27, Federal Communications Commission, Washington, DC, 1992. Also see Snider, *et al.*, “The Citizen’s Guide to the Airwaves.”

¹⁰ See “FCC NPRM & MO&O: Commission’s Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands,” WT Docket No. 03-56, April 2, 2003.

¹¹ See U.S. Department of the Interior, Office of Policy Analysis, “Improvements to the Federal Coal Leasing Program Linked to the Use of Intertract Bidding,” Report, April 1981.

¹² See David F. Linowes, Chairman, *Report to Congress: Commission on Fair Market Value Policy for Coal Leasing*, (1984): 216-222.

¹³ See Michael H. Rothkopf *et al.*, “Designing Purpa Power Purchase Auctions: Theory and Practice,” *Competition in Electricity: New Markets and New Structures*, James Plummer and Susan Troppman, Eds., Public Utilities Reports, Inc., Arlington, VA, (1990): 139-194.

¹⁴ “Efforts to extract gains from licensees ... should not be permitted unduly to hinder or delay realization of the public benefits from promoting greater competitiveness through spectrum liberalization.” Gregory L. Rossten and Thomas W. Hazlett, “Comments of 37 Concerned Economists,” Comment on WT Docket No. 00-230, FCC, 2001, p.6.

¹⁵ The units here may be unfamiliar to some. Dollars per MHz per Pop is the same as dollars per MHz-Pops. Both refer to the per capita cost of 1 MHz of spectrum. However, MHz-Pops, which are appropriate here, refer to the amount of bandwidth (MHz) multiplied by the population in the geographic area of the license.

¹⁶ The purpose of this proposed procedure is to prevent competitors of the service to be offered by the new licenses from delaying their competition.

¹⁷ For example, if a bidder with no value synergies between licenses is allowed to link bids on two licenses together so that both or neither of them must be awarded, then it is possible that another bidder offering a higher price for one of the licenses will lose. The inflexible bidder would then have bested a bidder offering more solely because of her inflexibility. Of course, if as is likely, only one bidder can bid competitively for each license, then this situation will not arise.

¹⁸ For a recent article, see Y. Fujishima *et al.*, “Taming the Computational Complexity of Combinatorial Auctions: Optimal and Approximate Approaches,” *Proceedings of the International Joint Conference on Artificial Intelligence (IJCAI)*, Stockholm, Sweden: (1999): 548-553.