Moving toward a Market for Spectrum

Evan R. Kwerel and John R. Williams

Cellular telephony is often cited as a success story, and in many ways it is. Customers have increased at an annual rate of about 40 percent, with 11 million users in 1992. Yet the development of cellular service might have occurred years ago if the United States had not been relying heavily on central planning to manage the valuable natural resource of radio frequency spectrum. That approach raises costs, limits innovation, and deprives the public of valuable services. A recent study by Jeffrey Rohlfs, Charles Jackson, and Tracey Kelly estimated that the regulatory delay in initiating cellular service cost the U.S. economy more than $86 billion.

The fundamental problem with the current system of spectrum management is the absence of flexible, well-defined, tradable spectrum rights. If spectrum parcels were privately owned, their owners would be free to combine or subdivide them, to provide whatever services they chose, and to use any technology that did not cause electrical interference with neighboring licensees. The government's role would then be limited to establishing and enforcing those property rights. That approach would not necessarily require eliminating all regulation of the services: broadcast and common carrier services could still be subject to today's nonspectrum regulations.

A complete changeover to a market system based on property rights is not likely to occur because of political opposition and practical considerations about how spectrum is currently used. We shall, however, suggest some incremental market-oriented reforms that should be politically acceptable and bring major benefits to Americans.

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Spectrum Management in the United States

In the United States spectrum is currently managed by administrative process. Licenses not only define the amount of spectrum (in frequency, time, and space) but narrowly specify the services licensees may provide and the technologies they may use. For example, a television broadcasting license entitles the licensee to provide only television service. The licensee may not, for example, use its spectrum for cellular telephone service, even if it is technically feasible to do so without interfering with other licensees.

The social loss from such restrictions can be significant. In an earlier study we estimated that permitting just one ultra-high-frequency television station in Los Angeles to voluntarily use its assigned spectrum for cellular telephone service could

"As an anthropologist, I've been to tropic jungles and frozen tundras. I've seen primitive cultures and sophisticated societies. But this is the only place where I've have been unable to figure out what's going on."

increase net social welfare by over $1 billion.

The current system also limits use of particular frequencies to certain classes of users. For example, large amounts of spectrum have been set aside for use by the federal government. The National Telecommunications and Information Administration (NTIA) manages that spectrum. The Federal Communications Commission manages the remaining spectrum, which is allocated to the private sector and to state and local governments.

The FCC uses a two-step process to manage the spectrum. First, it allocates bands of frequencies to a specific set of uses or services. That is analogous to the zoning of land, except that spectrum allocations are usually nationwide. After allocating a band, the Commission will typically subdivide it into smaller bands, sometimes called channels or blocks, which it then assigns to individual licensees on a local, regional, or nationwide basis. That is analogous to leasing land to a particular user, except that no rent is charged. Depending on the nature of the service, the FCC may assign a block of spectrum exclusively to a single licensee in an area, as in television broadcasting, or on a shared basis to many licensees, as in some of the bands allocated for private land mobile services.

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The FCC has two methods of selecting among applicants for exclusively assigned spectrum: comparative hearings, in which the Commission bases its selections on the relative qualifications of applicants, and lotteries, in which it randomly selects winners from a group of qualified applicants. The FCC grants most licenses today—except broadcasting licenses—by using lotteries.

A third method that the Commission might use in the future, if given legislative authority, is competitive bidding—auctions. In the spring of 1993, both the House and Senate passed versions of the Omnibus Budget Reconciliation Act (H.R. 2264) authorizing the FCC to use auctions to assign new commercial licenses through 1998 and requiring the agency to report the results to Congress. It does not, however, permit auctions to be used to assign licenses for "free" terrestrial broadcasting services. The legislation was expected to be enacted by the August congressional recess.

Providing Spectrum for New Telecommunications Uses

Ideally, entrepreneurs with ideas for new radio services or technologies should be able to purchase spectrum rights in the private market in much the same way as they purchase inputs such as land or steel. That would eliminate the regulatory delay and other costs associated with the administrative allocation and assignment processes. It would also ensure that each new spectrum use is at least as privately beneficial as the other uses it displaces. Under the current system, however, the proponents of new radio technologies or services must generally come to the government for spectrum.

There are basically four ways that the government can obtain spectrum for new uses. First, it

can allocate virgin spectrum. In the past the FCC has been able to accommodate many new uses by opening new bands at the upper end of the usable radio spectrum. That approach is attractive because it does not require displacing existing services or licensees. But the FCC has already allocated most of the spectrum of value for radio use. Therefore, the agency will have very limited opportunities to use this method in the future.

A second way to accommodate new private uses would be to reallocate spectrum from the federal government to the private sector. H.R. 2264, in addition to giving the FCC auction authority, would require NTIA to transfer to the FCC 200 megahertz of spectrum the federal government now uses. The bill would give the secretary of commerce 24 months to submit a final report identifying the frequencies to be reallocated. Within one year after the president notified the FCC of frequencies to be reallocated, the FCC would be required to submit to the president and Congress a plan for the distribution of the spectrum. Under that plan the FCC would gradually distribute some frequencies over a 10-year period but would reserve a significant portion for distribution after the 10-year period was over. Given the extended timetable, it is unlikely that such legislation would provide the private sector a significant portion of the federal government's spectrum in the short term.

A third way to accommodate new uses would be to reallocate spectrum that has not yet been assigned to individual licensees. In the 1960s and 1970s the FCC reallocated a large block of largely unassigned ultra-high-frequency television spectrum to cellular and other land mobile services. Unfortunately, no such large blocks of unassigned spectrum now exist in the frequency ranges most in demand for new uses. There are, however, fragments of unassigned spectrum in many bands that could be aggregated to provide spectrum for low-power services that are less likely to cause electrical interference.

Such spectrum fragments will be used in the initial implementation of personal communications services (PCS) in bands that were previously allocated to fixed services. PCS licensees will be permitted to use spectrum not currently occupied by fixed systems and may pay to move the fixed systems to other bands. Studies have indicated that in many areas there should be sufficient unassigned spectrum for the initial implementation of PCS so that the more costly reallocation of occupied spectrum will not be necessary immediately.

A fourth way to accommodate new services is by clearing spectrum that is currently allocated and assigned to other uses. On the rare occasions when the FCC has done that in the past, it mandated that existing licensees vacate the reallocated band after a long grandfathered period and then provided substitute spectrum for the displaced licensees. Mandatory band clearing was used during the 1980s to reallocate spectrum from fixed service to direct broadcasting satellite service. As the spectrum becomes more crowded, however, providing substitute bands for displaced users will become more costly and may set off a chain reaction of additional reallocations and dislocations. Long grandfathered periods may also impose unacceptable delays in the implementation of new services at a time of accelerating technological change and intense international competition.

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As an alternative to the mandatory clearing of bands, the reallocation of occupied spectrum could be done voluntarily. The new service would be licensed in the same band as existing services, and existing licensees would be allowed to continue their current spectrum usage indefinitely or to sell out to the new service licensees. In some instances, as in the ultra-high-frequency television band, an existing licensee may have sufficient spectrum within its current assignment to provide the new service itself, in which case even the cost of relicensing could be avoided. By making the reallocation of occupied spectrum voluntary, existing licensees would have no reason to oppose it and might support it if they thought it would be profitable.

Recent FCC Experience Reallocating Spectrum

In its emerging technologies rulemaking the FCC combined various approaches to reallocat-

ing spectrum. In September 1992 the Commission essentially reallocated to emerging technologies the unoccupied spectrum in three bands containing a total of 220 megahertz: 1850 to 1990 megahertz, 2110 to 2150 megahertz, and 2160 to 2200 megahertz. Incumbent public safety licensees in those bands are grandfathered indefinitely, but may vacate the band voluntarily at any time. Non-public safety incumbents are similarly grandfathered for two years. At the end of that period, an emerging technology licensee will be able to require a non-public safety incumbent to move if the new licensee pays all moving costs.

While not a pure market approach, the plan the FCC adopted is likely to produce a relatively efficient movement of spectrum from existing to new uses. The FCC's plan ensures that incumbents in the band will not be moved without compensation and guarantees potential emerging technology licensees that most incumbents cannot refuse to move or hold out for exorbitant compensation. One way that the Commission's approach to the reallocation of occupied spectrum in the proceeding departs from a market mechanism is in its provision for involuntary relocation. Given that the incumbents in these bands include regulated utilities and state and local government agencies, a purely voluntary approach may have resulted in too little spectrum being transferred to new uses, even though such uses are socially more beneficial. The provision for mandatory relocation after some period of time addresses this problem—but only in part, since it does not apply to public safety licensees.

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It is less clear whether efficiency is enhanced by subjecting unregulated private licensees to involuntary relocation. On the one hand, by limiting what incumbents may charge for their spectrum rights, the FCC may have greatly reduced transaction costs in situations where a single incumbent holdout can block a new licensee from providing service over a significant geographic area. On the other hand, limiting compensation may signal to incumbents in other bands that they will be unable to reap the benefits of reallocating spectrum to higher valued uses. This would weaken their incentives to seek out socially beneficial reallocations. In any case, compared to uncompensated mandatory relocation, requiring new licensees to pay incumbents the cost of relocation greatly reduces incumbents' incentive to delay the process and ensures that relocation costs are incurred only where they produce at least equivalent private benefits.

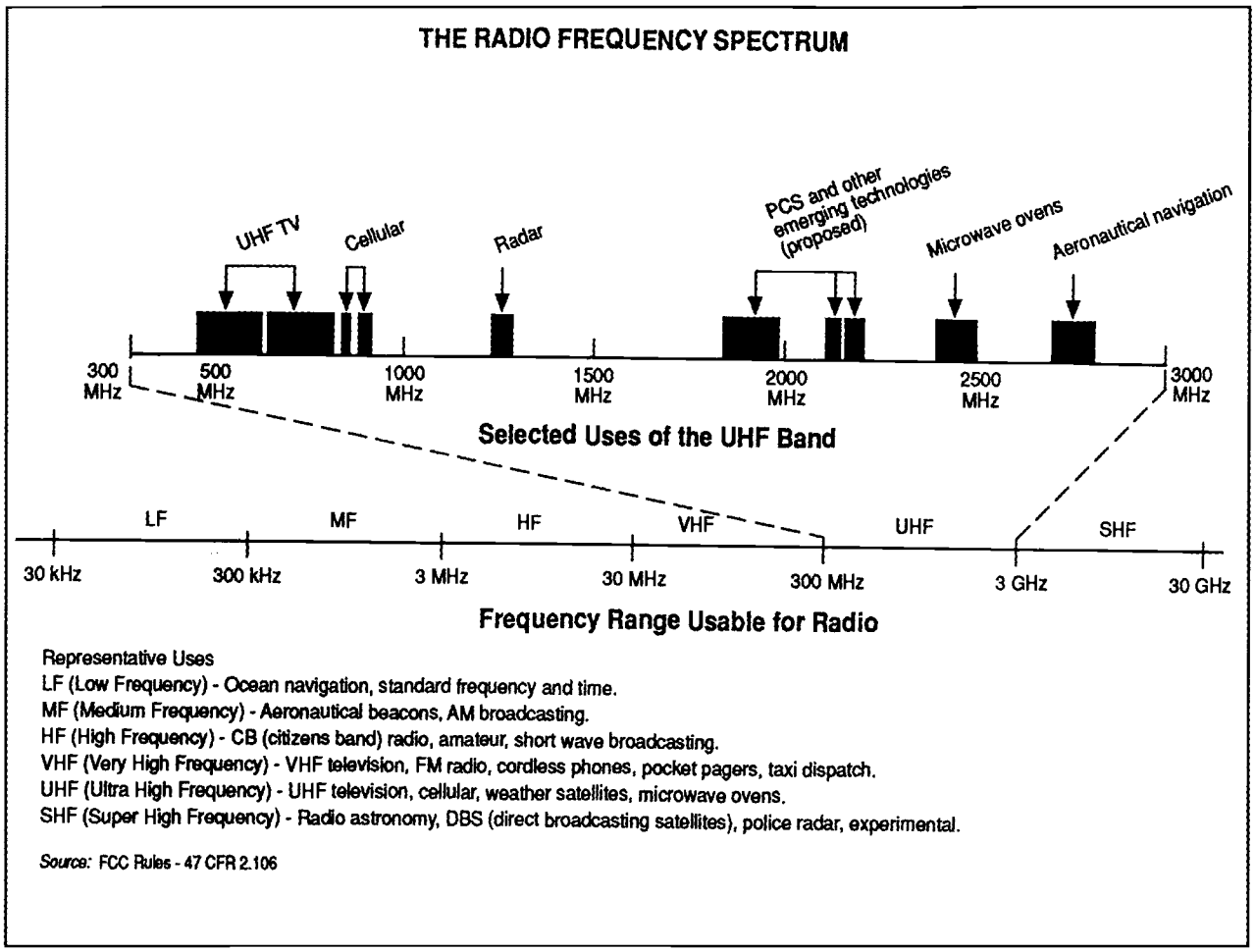
Finally, the FCC's plan would not be a pure market approach even if all reallocations in the emerging technologies band were voluntary, because it would not fully account for the opportunity cost of the spectrum in other bands used to relocate the incumbent systems.

The FCC will assign spectrum in the new band at no charge to incumbent licensees moving from the two-gigahertz band to some higher frequency. Although the emerging technology licensees will have to pay engineering and coordination costs necessary to locate and secure replacement frequencies, they will not pay the opportunity cost of foreclosing other uses of that spectrum. Thus, they may move an excessive number of fixed-service systems.

One sticking point in the FCC plan was the status of unassigned spectrum in the band. Under the existing allocation, fixed users had an implied property right to this spectrum for future expansion of their systems. The FCC plan would convert this implied property right into an explicit right and reassign it to new licensees.

One option would have been to not immediately assign unused spectrum in the band exclusively to emerging technology licensees but hold it in reserve for piecemeal assignment to either emerging technology or fixed-service licensees on a first-come, first-served basis. However, this approach could lead to serious inefficiencies for several reasons.

First, assigning spectrum on a first-come, first-served basis may create a "land rush" mentality. Potential users of spectrum, in this case emerging technology and incumbent fixed-service licensees, would have an incentive to build inefficient systems to claim unoccupied spectrum before someone else does. Besides wasting



resources, such behavior may prompt the FCC to impose rigid spectrum efficiency or "need" type regulations on the new, emerging services. Not only would that add to regulatory delay, but it would limit the flexibility of the emerging technology licensees to develop low-cost, mass-market services.

Second, voluntary negotiations cannot be relied on to provide an economically efficient outcome when much spectrum remains in an unassigned and implied common property pool. If, for example, an emerging technology licensee wished to assure its future right to expand in some location on unassigned spectrum, it would need to negotiate with *all* potential claimants of that spectrum. If the FCC narrowly defined the rights of fixed-service licensees to expand their systems, the number of potential claimants may be small enough that such negotiations may be feasible, although difficult. A liberal interpretation of the provision, however, could encompass so many fixed-service licensees that negotiations would be unfeasible.

In contrast, assigning all unoccupied spectrum in the band to emerging technology licensees would eliminate uncertainty as to how much of that spectrum would be available for emerging technology use in the future. If an emerging technology licensee needed more spectrum, it could negotiate with the individual fixed-service users to which that spectrum is assigned. Conversely, if a fixed-service licensee required additional spectrum in the two-giga-

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hertz range, it could negotiate with the emerging technology licensee or other fixed-service users to which that spectrum is assigned. In either case spectrum would go to its highest-valued use, and licensees would have an incentive to use spectrum efficiently. In deciding how much spectrum to use themselves, they would consider the payment they could receive by transferring that spectrum to others.

This approach would, however, impose costs on incumbent users in the two-gigahertz band. Before the proposed emerging technologies reallocation, fixed-service users had the expectation that if they wished to expand their facilities, the FCC would assign them additional spectrum at no charge. Taking away their right of "free" expansion could prompt them to oppose and delay the process.

Nevertheless, in the end the FCC decided to assign most of the rights to unoccupied spectrum to new licensees. It concluded: "Existing two GHz fixed facilities, licensed before January 16, 1992, can make certain modifications and minor extensions and retain primary status. Major extensions or expansions would be considered secondary, unless a special showing of need is made to justify primary status." New fixed-service facilities will be licensed only on a secondary basis.

As a third alternative, the FCC could have considered making the rights to unoccupied spectrum explicit and immediately assigned them to incumbents. This might have been done using a lottery in which tickets were issued in proportion to current spectrum usage, a proxy for an incumbent's likely future claim on vacant spectrum in the band. Once all the spectrum rights had been defined and exclusively assigned, they could be traded to the parties who value them the most. Limiting a lottery for emerging technology licenses to incumbents in the band would probably not withstand court challenge. But implicit property rights to unassigned spectrum must either be vested in the incumbents or reassigned to new licensees if we are to convert from an administrative regime where the FCC holds spectrum in reserve and issues it on an as-needed basis to one in which spectrum can be obtained through ordinary market transactions.

Unless the FCC is able to charge the market price for such licenses, whether through auctions or appropriate license fees, much of a license's value is likely to be dissipated though rent seeking.

Mechanisms for Assigning Spectrum

Reallocating spectrum for new services is generally only the first step in getting spectrum into higher-valued uses. If the spectrum to be reallocated is exclusively assigned and the assigned blocks are sufficiently large, as in the case of occupied ultra-high-frequency television spectrum, then broadening the allocation to include additional uses, such as cellular, is essentially all that is needed. If spectrum that is currently unoccupied is to be assigned on an exclusive basis, however, some method must be used to select among mutually exclusive applicants. Unfortunately, unless the FCC is able to charge the market price for such licenses, whether through auctions or appropriate license fees, much of a license's value is likely to be dissipated though rent seeking—socially unproductive expenditures made by private parties seeking to acquire a license.

Historically, comparative hearings were the FCC's primary way of selecting among competing applicants. Depending on the level of review, an administrative law judge, the review board, or the full Commission would evaluate applicants under comparative criteria. There has often been substantial disagreement about what the comparative criteria should be and how they should be weighted. It was not uncommon for hearings to drag on for years, with participants incurring huge legal bills.

In 1982 Congress gave the FCC authority to award licenses by random selection. The private sector was quick to respond to the new selection procedure. Application "mills" soon offered a standard lottery application at a modest price. FCC application fees were low as well—zero until 1987 and currently only $230 for a cellular license application. Because the cost of applying was low and the licenses were quite valuable, large numbers of applicants chose to enter the FCC lotteries. For example, there were nearly 400,000 applications for cellular licenses—so

many that the shelves broke at the FCC processing center in Gettysburg.

A third possible selection method that could be used if Congress granted the necessary authority is competitive bidding—auctions. Auctions would award FCC licenses to those willing to pay the most for them. Competitive bidding has been used to award spectrum licenses in New Zealand and the United Kingdom. Although auctions have never been used to award FCC licenses, the federal government has used them extensively to issue other valuable rights. For example, the U.S. Department of the Interior has been using competitive bidding since 1953 to award leases on oil and natural gas tracts in the Outer Continental Shelf.

Effect on Ownership. The initial licensing method will generally have little effect on the ultimate distribution of license ownership if resale of licenses is permitted. Currently, resale is permitted with relatively few restrictions, and there has been considerable license trading. Thus, in the long run the ultimate ownership distributions will be about the same under all three methods of selecting initial licensees. Therefore, the potential for monopolizing the spectrum, if it were possible, would be no greater under competitive bidding than under the current selection methods. In addition, strict technical and financial qualifications, often used in attempts to limit lottery speculation, have little, if any, effect on the ultimate ownership of licenses but can be costly to administer and enforce.

Delay in Licensing. Delays in choosing licensees deprive the public of communications service. Comparative hearings are likely to have the greatest delays. Even with streamlined hearings, it took the FCC an average of two years to award the "nonwireline" cellular license in each of the top 30 markets. (Those were the licenses not limited to the local telephone companies.) Selecting licensees through lotteries also causes delays because of the large numbers of applicants and time spent reviewing the qualifications of tentative selectees. After the FCC switched to lotteries in cellular service, the average time to award a nonwireline license decreased but still averaged over one year. Overall, it took the FCC over six years from the time it decided to use lotteries in cellular service until the last lottery was held.

Competitive bidding is likely to reduce licensing delays. First, it will attract fewer applicants than lotteries because the winner of an auction must pay for the license. Also, by eliminating the incentive for speculation and ensuring that licenses are awarded initially to those who value them the most, a pure competitive bidding approach (*i.e.*, one unconstrained by additional social objectives such as ensuring small business participation) eliminates the need for the FCC to examine licensees' technical and financial qualifications. Thus, administrative delays are likely to be far shorter under competitive bidding once it is fully implemented.

In any case, current application fees are intended to cover only the FCC's cost of regulation and not to reflect the value of the benefits the licenses confer. Thus, they are too low to be much of a factor in the selection mechanism. In addition, statute specifies current fees. The FCC cannot increase them at its own discretion.

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Lotteries would likely impose a greater delay than a well-run government auction. Because lotteries select licensees randomly, the licenses generally must be resold before service is provided. Auctions minimize post-licensing transactions, and the parties who value the licenses the most receive them immediately.

Cost of Rent-Seeking. Under comparative hearings or lotteries, as currently structured, applicants must use up real resources to increase their probability of winning a license—primarily the time of lawyers in preparing "better" or more applications. Under competitive bidding, however, applicants must only be willing to transfer more resources (in the form of a higher bid) in order to increase their chance of winning. Thus, competitive bidding would reduce the real resources used up in applying for a license.

The social waste associated with lotteries or

comparative hearings could be reduced by increasing application or licensing fees. Fees, just as the bid paid by the auction winner, are pure transfers. If the license fee could be set at the amount the highest bidder would be willing to pay, there generally would be only a single applicant, and lotteries or comparative hearings would either be unnecessary or equivalent to an auction. In reality, the FCC is not likely to be able to estimate accurately the market value of a license. It may either set the license fee too high and have no applicants or set it too low and have multiple applicants. If it then adjusts the fee until there is just one applicant, it would get the same result as an auction but would have significantly delayed the outcome and used up more resources in the process.

Cost of FCC Licensing. Government administrative costs of licensing are likely to be highest for comparative hearings and lowest for competitive bidding. With a fixed overall FCC budget, conducting comparative hearings would either take a very long time, and thus delay the implementation of the service, or significantly divert resources from other agency activities.

At present, an entrepreneur seeking to acquire sufficient spectrum to support the development and manufacturing of new equipment or the marketing of a new service would have to obtain the agreement of hundreds or even thousands of licensees.

Efficiency of Postlicensing Spectrum Use. With auction authority the FCC would be less likely to use inefficient regimes for sharing spectrum to avoid comparative hearings or lotteries. Because comparative hearings or lotteries place an administrative burden on the agency, it has an incentive to prevent mutually exclusive applications. One way it can do that is to allow multiple licensees to share the same spectrum instead of assigning exclusive licenses. The FCC used that approach recently in licensing air-to-ground service. But the problem with assigning spectrum on a shared basis is that individual licensees have little incentive to conserve on the use of the spectrum since other users gain most of the benefit of such conservation. This has been the FCC's experience with traditional land mobile services, which are characterized by an excessive number of mobile units, each providing low-quality service. In contrast, the FCC has found that specialized mobile radio operators, who are awarded spectrum on an exclusive basis, have voluntarily used spectrum-conserving equipment.

While some have argued that shared use facilitates competition by allowing free entry, the opposite may well be the case. Under a system of exclusive assignments, a licensee need not go to his competitors to adopt a technology that will dramatically increase capacity. But shared-use systems, which require extensive technical coordination among firms, could facilitate collusion by competitors to restrict expansion of total output so that they could maintain higher prices.

Another shared-use scheme the FCC has adopted to avoid mutually exclusive applications is to require applicants to form a consortium. The Commission used that approach in licensing mobile satellite service. MCI and others have proposed it to expedite the licensing for personal communications services. While forming a consortium may speed up licensing, it is likely to create an overlay of problems in providing the service. Forcing unwilling partners into a single business enterprise cannot bode well for the smooth operation of the firm.

Other considerations. Competitive bidding has two additional benefits. First, it would generate information on the value of spectrum in alternative uses that the FCC could use in future spectrum-allocation proceedings. Second, competitive bidding would give taxpayers a return for the value conferred in a license.

Moving toward Market-Based Spectrum Management

Providing greater opportunity for entrepreneurial involvement in spectrum management will greatly benefit the public. Granting existing licensees flexibility to change the technologies they use is an important reform that the FCC has already begun and should continue. Additionally, where the Commission assigns spectrum exclusively, we recommend expanding

that flexibility to include the choice of what services are to be provided, not merely how they will be provided. That would allow not only the upgrading of technology but the reallocation of spectrum from lower- to higher-valued uses as changes occur in the marketplace.

While increasing the flexibility of existing licensees is a necessary first step, it is not sufficient. At present, an entrepreneur seeking to acquire sufficient spectrum to support the development and manufacturing of new equipment or the marketing of a new service would have to obtain the agreement of hundreds or even thousands of licensees. Such high transaction costs greatly diminish the expected gains from the application of flexibility to existing spectrum assignments. Also, in many bands much of the total spectrum is not assigned to any licensee and is therefore not available for acquisition.

One way the FCC can reduce the private costs of aggregating spectrum is to create an overlay of nationwide or regional band assignments in spectrum that is currently used for commercial services. In addition to being nationwide in coverage, such band assignments should be wide enough in frequency to permit a variety of uses and to achieve economies of scale. There should be few or no constraints on the types of services that could be provided or the technologies used. Band licensees should be given exclusive rights to the unassigned spectrum in the band and could negotiate with current occupants for additional space. Thus, band licensees would be in a position to aggregate the spectrum into larger, more efficient blocks and to perform on a competitive, entrepreneurial basis most of the detailed resource allocation, management, and enforcement functions the FCC and other frequency coordination groups currently perform.

With a fully implemented system of band licenses, the Commission's primary spectrum management role would be to enforce the boundaries between band licensees. While the majority of the spectrum could be included in band licenses, some bands should be reserved for special services, such as public broadcasting or public safety, for which a market-based allocation may not adequately provide. In some of those public bands the FCC could function as detailed spectrum manager, as it now does, or it could delegate that authority to nonprofit organizations representative of the particular services.

Some of the options the FCC has proposed in the personal communications service proceeding are functionally equivalent to band assignments and should be given serious consideration. The concept has already been studied extensively and is gaining acceptance in other countries. New Zealand, for example, is now converting to such a system across practically the entire spectrum and is auctioning licenses. Implementing the system in the United States will be more complicated, even assuming the FCC is given auction authority, because unlike New Zealand, we have no large blocks of unassigned usable spectrum. We believe, however, that the potential benefits to the economy and to our international competitiveness justify the effort.

Ideally, government spectrum users should have to compete in the market with private spectrum users in the same way they normally compete for other resources such as land or personnel.

We also strongly urge that the government charge market prices for newly issued licenses. In the private sector only charities give away valuable rights for free. Yet the FCC continues to award licenses for only the cost of administering the giveaway. In a lottery the result is a huge number of applicants and occasionally fraudulent behavior. In comparative hearings there are lengthy delays as the FCC and sometimes the courts attempt to determine which applicant is better than the rest.

Ideally, the FCC should use auctions to award new licenses. Auctions would automatically establish the market value of licenses. Auctions would also be particularly appropriate for awarding band licenses since a comparative process would make little sense when the output service is not specified. Fortunately, Congress is likely to pass legislation giving the FCC explicit authority to use auctions.

Finally, we believe that more spectrum should be transferred from government to private use. Ideally, government spectrum users should have to compete in the market with pri-

vate spectrum users in the same way they normally compete for other resources such as land or personnel. Failing that, serious consideration should be given to forcing the government to face more fully the opportunity cost of the spectrum. One way to do that is to reallocate spectrum from government to nongovernment use as provided in H.R. 2264. That is superior to increasing shared use between government and private users. With shared use private parties have weakened incentives and opportunities to economize appropriately on their use of spectrum. That is particularly true when the sharing party is the government, because of the complicated coordination procedures and technical restrictions that accompany such arrangements.

Allowing for the play of market forces in the allocation of spectrum and allowing spectrum licensees greater leeway in choices of technologies used and services provided will open up new possibilities in increased efficiency and innovation in one of our economy's most dynamic sectors.

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