

HUDSON INSTITUTE INITIATIVE ON FUTURE INNOVATION

OPEN SPECTRUM

A MAJOR STEP FOR U.S. INNOVATION AND ECONOMIC GROWTH

Harold Furchtgott-Roth



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Senior Fellow, Hudson Institute, July 2013



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Open Spectrum: A Major Step for U.S. Innovation and Economic Growth

Harold Furchtgott-Roth, July 2013

This paper proposes that the Federal Communications Commission adopt rules to allow practically all of the electromagnetic spectrum to be allocated flexibly in response to market conditions and to allow licensees to use their spectrum flexibly. This approach is consistent with the direction of FCC decisions to allow greater spectrum flexibility and would be economically far superior to recent FCC proposals for broadcast spectrum auctions. Spectrum flexibility—or “Open Spectrum”—would eliminate the much-lamented wireless broadband “shortage” without delay and would foster greater innovation in American spectrum markets and transactions and in wireless services and products. The economic value of Open Spectrum is probably orders of magnitude greater than the projected \$15 billion in receipts from the FCC’s broadcast spectrum auctions.

HUDSON INSTITUTE INITIATIVE ON FUTURE INNOVATION

is an effort to understand and sustain American technological innovation. Each booklet in the Future Innovation series examines innovation in a specific policy area, offering a detailed look at past developments, present policies, and opportunities for change.

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OPEN SPECTRUM

A MAJOR STEP FOR U.S. INNOVATION AND ECONOMIC GROWTH

Introduction and Summary

All successful economies rest on two elementary principles of property and exchange:

- 1.** Individuals are free to determine the *use* of assets under their control.
- 2.** Individuals are free to *buy* and *sell* assets.

Neither principle is absolute: the use of assets may be conditioned by nuisance and trespass law or environmental regulation, and the exchange of assets may be conditioned by general or specific restrictions (antitrust law, firearms regulation) or outright prohibitions (narcotic drugs). But these are exceptions—aimed at *vindicating* property rights and economic efficiency or at bolstering non-economic social norms. The principles themselves are fundamental, permitting resources to be owned by those willing and able to put them to their highest-valued uses. Take away either principle, and resources will languish. Not only are the owners of the resources harmed by the absence of either principle, but so too is everyone in the broader economy. The economic benefits from these principles have been widely recognized since Adam Smith.

In the United States, these principles hold true for practically all assets except one—the electromagnetic spectrum. Under current law, the Federal Communications Commission

regulates who may use spectrum and for what purposes. Ownership of spectrum is reserved for the federal government, with usage licenses granted at the discretion of the FCC. Licenses may be transferred only with the approval of the Commission, which sometimes subjects transfers to detailed conditions unrelated to its rules or statutory authorities.

These regulatory controls go far beyond what is necessary to mediate interference among competing spectrum uses (a straightforward matter of property definition and nuisance law), and in important respects have made interference problems worse. They have seriously impeded technological innovation and economic progress in the past and are doing so today. The FCC has made substantial progress in recent years in relaxing usage restrictions for spectrum and easing the transfer of spectrum usage rights in specific secondary markets. However, it has yet to free itself from a command-and-control framework that vests in it the power to decide what are acceptable uses of spectrum and who may own spectrum licenses.

Consistent with current law, the FCC could and should adopt a more flexible approach to spectrum management. I call it “Open Spectrum.” Open Spectrum has two major elements:

- 1.** Consistent with current law, the FCC could continue to manage licenses for spectrum, but licensees could use their spectrum for wireless broadband, satellite services, or even broadcasting.
- 2.** Consistent with current law, licenses could be bought and sold through contracts like other forms of property.

Open Spectrum is remarkably simple. It washes away hundreds of pages of obscure and confounding rules written and accumulated over much of the past century to limit the use and transferability of spectrum licenses. Many of these rules serve no economically beneficial purpose today, if they ever did. But the rules do prevent spectrum from being put to its best use.

That is an enormous policy mistake. Spectrum is one of our most precious renewable resources. The use of spectrum today does not reduce its availability tomorrow. Unlike solar power or many other forms of renewable energy, spectrum cannot be stored today for use tomorrow. The value of wasted spectrum today is lost forever.

Issues of interference among competing spectrum users are common today even with regulation on the use of spectrum. These issues are resolved either directly, among the users themselves or, failing that, at the FCC. Although management of spectrum interference might take a different form with Open Spectrum, the mechanisms for management are already in place.

The benefits of Open Spectrum to the American economy would be substantial, likely in the hundreds of billions of dollars of consumer surplus annually.² Measures of consumer surplus are based on a static technology; entrepreneurs and innovators would likely employ Open Spectrum with new services and products that are unimaginable today.

The FCC has full legal authority to implement Open Spectrum today. It merely needs the will and judgment to lead the way.



Wireless services built on private investment have driven economic growth in America.

In every home and school and at practically every workplace in America, new wireless services have changed how we live, learn, and work. In smartphones and tablets, cellular towers and wireless modems, we see the tangible manifestation of wireless America. This new wireless world has been created in America and around the globe by individual innovators. Official reports crow about the growth of the wireless world as if government agencies created it. All too often, government agencies have impeded the development of the wireless world, particularly in the realm of wireless spectrum markets, and they unwittingly still do so today.

Wireless spectrum—consisting of the radio waves that transmit wireless communications—is heavily regulated by governments around the world. Unlicensed spectrum, particularly useful for short distances for such applications as Wi-Fi and Bluetooth, is accessible to any user but still regulated. Licensed spectrum, particularly useful for longer-distance communications such as those using cellular architectures or satellites, is heavily regulated.

The structure of wireless spectrum regulation is distinctly national. While each country has its own set of regulations, U.S. regulation has tended to be similar to that of most other countries. But, as will be described in more detail below, regulation (including in the United States) has still slowed the development of new wireless services. The wonder is not that the wireless world developed; the wonder is that it developed despite substantial government interference. Federal spectrum regulation still impedes the development of more efficient spectrum markets that could lead to innovations in wireless markets, transactions, products, and services.

Although markets for wireless devices and services are often global, and the benefits of product and service innovation inure to the benefit of all consumers worldwide, improvements in American regulation and in the flexibility of U.S. spectrum markets would accrue primarily to the benefit of American consumers.

The challenge for our government today is not to engage in industrial policy to favor the wireless world at the expense of other industries; the challenge is to liberalize the artificial restraints on spectrum use that are impeding the development of the wireless world. Such a step would not cure all of the ills of the larger world. But it would lead to more innovation in the wireless sector and consequently to a more prosperous American economy.

The economic value of a flexible approach to spectrum for the wireless world is substantial. Just one year of the economic advantages of Open Spectrum is worth an order of magnitude more than entire auction receipts for broadcast spectrum, auctions that will not occur for many years.³ But the economic advantages of Open Spectrum, unlike spectrum auctions, are not one-time events. They are repeated year after year, and over a ten-year period these advantages are likely to be orders of magnitude greater than those of the proposed spectrum auctions. Open Spectrum can help awaken America to the possibility of a new wireless world built on unimagined innovation. The federal government could take many steps in that direction, but the most important would be simply to allow resources to be applied to their highest-valued uses.

Economic activity flourishes when resources are allowed to seek their highest-valued use.

In an efficient economy, resources are not permanently allocated for one purpose. At various times, much of Manhattan was farmland, most publicly traded securities were in the railroad industry, and millions of Americans were employed primarily as typists. As technology and market conditions change, resources are reallocated accordingly. If America were locked into the decisions of the past, we would be a much poorer country. The economic growth and innovativeness of America depend on the ability of individuals to pursue more attractive jobs and of businesses to reallocate resources in response to changed circumstances. The more easily America can react to changes in economic conditions, the more rapidly America grows.

Similarly, in an efficient economy, assets can be bought and sold. Thus, individuals and entities pay for the privilege of putting a resource to use. If an asset can be put to a better use, someone may purchase the asset and put it to that use. In an efficient economy, assets are frequently bought and sold, constantly moving to higher-valued uses.

Practically all major resources in America can and do respond to changing economic conditions. Bushels of wheat go to mills that are willing to pay for them. Investment capital goes to investments that offer the highest returns. High school athletes go to colleges that recruit them. Homes are sold to those willing to pay for them. Seemingly worthless particles of plastic, silicon, and other materials are combined to form highly valued smartphones. And land in Manhattan is no longer primarily used for farming.

Matching assets with those who value them is how markets work. It is how America works.

The matching of resources with their highest-valued use does not come about by government allocation or technological standard setting. The New York government in the seventeenth and eighteenth centuries did not permanently allocate Manhattan land for agriculture. Nor did standards-setting bodies decree that certain agricultural technology be forever used in Manhattan.

Spectrum does not easily flow to its highest-valued use because usage is restricted.

In the United States, wireless spectrum is artificially impeded from moving to uses that consumers and producers value most. Existing spectrum allocations are difficult to change because the government makes most allocation decisions, and government decision making—even with the best of intentions—is inherently more cumbersome than markets and less responsive to change and to varying local circumstances.

In the 1910s and 1920s, the federal government asserted ownership over the radio spectrum, and it has subsequently licensed and regulated its use.⁴ Although lawyers⁵ and economists⁶ have long noted that markets could more efficiently manage the allocation and assignment of spectrum, the FCC has persisted in exerting detailed control over spectrum allocation and use.

Since its founding eighty years ago, the FCC has allocated bands of spectrum for specific purposes, such as “maritime radionavigation,” “aeronautical radionavigation,” “amateur radio,” and “radio astronomy.” Some frequencies are assigned to the federal government, others are assigned to licensees for specified commercial uses. Most spectrum has multiple users occupying the same frequency band, with “secondary” users—and even lower-priority users—obliged to avoid radio interference with “primary” users.

Because the federal government controls spectrum, allocations for a specific purpose are typically nationwide. Residents in one community cannot allocate more spectrum for amateur purposes and less for radio astronomy.

In addition, once the FCC allocates spectrum for a specific purpose, it rarely changes the allocation. Reallocation proceedings can take years to complete. The spectrum for broadcast radio was allocated in the 1920s. The FCC began allocating spectrum for broadcast television in the 1940s⁷—and much of it lies dormant and unused today, even

as newer technologies for wireless voice, data, and video communications are starved for spectrum of the same frequencies.

Shifting spectrum from one purpose to another, or placing it in a complicated transaction or novel use, is often prohibitively slow and costly. The owner of a broadcast television license who wants to use spectrum for a purpose different from its current allocation must apply to the FCC for permission and then wait months and even years for a decision. And a licensee who wants to use the spectrum exclusively for a purpose other than broadcasting will discover that the FCC will not allow this. If America approached land use in the same way that the FCC approaches broadcast spectrum use, Manhattan would still be farmland.

Spectrum allocations may change once every few decades after lengthy public proceedings. Over the past twenty years, the FCC has reallocated many blocks of spectrum for various commercial mobile uses, recently with increasing flexibility. Examples include 2.5 GHz,⁸ 2.3 GHz,⁹ the LightSquared mobile satellite service spectrum,¹⁰ and S-band MSS spectrum.¹¹

The general success of greater spectrum flexibility raises the question of why the FCC does not grant flexibility for all spectrum bands. Not only does the Commission continue to regulate the specific use of spectrum in most bands, it often regulates the specific technology or technological characteristics for that use. For example, it requires specific transmission technologies for television broadcasting, and even mobile service spectrum bands often have limits on power levels and architectures for cellular systems.

Although spectrum flexibility is often described as “de-zoning,” federal spectrum regulation tends to be far more restrictive than zoning of land use. Local governments and associations of property owners often create zones for residential housing, commercial and industrial uses, lot sizes, and so on. But real estate zoning differs from spectrum allocation in many respects:

- Zoning pertains to property unambiguously owned by an individual or other entity, while spectrum allocation pertains to an asset for which the federal government claims ownership, and whose use is merely licensed.
- Zoning is local and variegated, while spectrum allocation is typically nationwide and inflexible. Unlike federal spectrum allocation, local zoning rules change, not infrequently, in a manner intended to improve land values.
- Property owners may petition local officials for variances, and reviews of such petitions are usually conducted—and often granted—in

a matter of weeks. FCC licensees can petition the FCC for waivers to spectrum allocation, but these petitions often take more than a year,¹² and the waivers are not necessarily permanent.

■ Real estate is partitioned into millions of parcels allocated by a vibrant market. Individuals seeking to purchase real estate zoned for a particular purpose in a particular location have many alternatives. Those seeking spectrum for a particular purpose in a particular location usually have no good alternatives.

Spectrum does not easily flow to its highest-valued use because transactions are limited.

The FCC also reviews and limits spectrum license transfers. Eager sellers of spectrum may find willing buyers, but standing between them is a government agency that usually delays, often discourages, and sometimes prohibits even simple, unproblematic transactions. The government prohibits many spectrum transactions and uses or imposes costs that effectively prohibit them.¹³ Often these transactions are not even particularly complicated and simply involve one entity seeking to continue to use a license for the same purpose.¹⁴

Despite FCC regulation of all license transfers, progress has been made. With each passing decade, license transfers have become easier and more predictable. As technology has advanced, more spectrum has been made available for commercial use. The development of today's wireless, satellite, and cable industries has depended on the FCC's making some spectrum available to them. As a result of the Omnibus Budget Reconciliation Act of 1993, the FCC received authority to auction spectrum licenses as a means of assigning them.¹⁵ The Balanced Budget Act of 1997 gave specific authority for the FCC to auction broadcast licenses.¹⁶

Today, the FCC has all of the legal authority it needs to conduct almost any form of spectrum policy. The Commission's tentative relaxations of regulation of spectrum transactions have been entirely salutary and free of untoward consequences. It turns out that detailed regulation of transactions is neither necessary nor beneficial.



Spectrum interference does not justify prescriptive regulation of spectrum use or transactions.

Despite its initial successes with spectrum liberalization, the FCC continues to adhere to a centralized planning model for spectrum allocation and license assignments and transactions. Though this model has evolved, it has not fundamentally changed over the past eighty years. There are intensely practical, political reasons for the model's persistence. It creates an artificial spectrum scarcity that concentrates economic power in Washington. It provides the FCC with immense discretionary power over critical sectors of the American economy, which it may exercise in unrelated matters such as merger approvals and sustaining political support from Congress.

But there is one rationale for the current system that some disinterested observers take seriously: the problem of spectrum interference.¹⁷ Interference may occur between users of adjacent bands of the frequency spectrum or between users of the same bands in adjacent geographical locations. These circumstances, it is argued, require detailed prescription of spectrum allocation, use, and ownership—or, at most, limited liberalization involving tightly controlled government spectrum auctions (as discussed below). Without such controls, goes the argument, competing private uses of spectrum would result in a cacophony of interference that would make the spectrum less useful for all.

This argument is fundamentally misconceived. Spectrum interference is common under the current system of FCC controls. Interference disputes are often resolved between private parties based on mutual interest rather than regulatory refereeing. It is common, for example, for broadcasters to adjust the placement of transmitters on towers to accommodate the signals of other broadcasters. When interference disputes are left to regulatory procedures, resolution is often elusive. For example, the FCC has failed to resolve interference disputes in several proceedings, including mobile satellite spectrum,¹⁸ WCS,¹⁹ and 900-MHz spectrum.²⁰

Interference disputes will develop under Open Spectrum as under current arrangements, but they can be resolved directly among the spectrum users with existing or new legal instruments. Conflicting property right claims are hardly unique to spectrum; they are an inescapable feature of all scarce resources and all forms of property. Spectrum interference is, of course, typically a question of degree along a range of stronger and weaker interference. But so are many familiar questions of conflicting use, involving both tangible resources such as real estate (easements, trespass, ground and air rights)

and intangible resources such as intellectual property (fair use, prior use, secondary meaning). Property law exists precisely to mediate partial and incremental resource conflicts in order to produce the largest social value.

Technological change often leads to new forms of property, such as new forms of physical plant and equipment, including railroads in the nineteenth century and new varieties of intellectual property today. Historically, the evolution of property law to accommodate new technologies has been a matter of acquired practical experience reflected in private law and institutions. Almost uniquely among property created by innovation, spectrum rights have been subsumed by governments. This outcome is not necessary.

Unlicensed uses are consistent with Open Spectrum.

Today, licensed spectrum coexists with unlicensed spectrum. Countless billions of unlicensed devices and applications enhance the value of consumer electronics. The same smartphone that allows consumers to connect via licensed spectrum to cellular networks also allows them to use unlicensed spectrum to connect to Wi-Fi networks or to use Bluetooth technologies to connect to other consumer electronic devices. Today, unlicensed applications use standardized technologies certified through standard-setting bodies such as the IEEE in an effort to limit interference. The same unlicensed technologies that operate today to the benefit of all consumers would continue to operate under Open Spectrum.

American consumers have been harmed by the misallocation of spectrum.

Federal regulation of the permitted uses of spectrum has resulted in serious economic harm in the past. Between the 1950s and the 1980s, the FCC delayed or blocked applications for new wireless services and development of wireless spectrum, as well as new services such as cable. The value lost to the American economy during this

period from just the undeveloped wireless services is difficult to calculate, but twenty years ago it was estimated at more than \$80 billion.²¹ The FCC delayed many other services as well.²²

The costs of misallocated spectrum today are certainly higher than in the past. Estimates in 2008 of the lost consumer surplus associated with misallocation of certain bands of broadcast spectrum were in the hundreds of billions of dollars annually.²³ The tremendous growth of wireless mobile communications in the subsequent five years, with no commensurate growth in available spectrum, suggests that the lost consumer surplus today must be even greater. The net present value of the lost consumer surplus over many years surely exceeds \$1 trillion.

These estimates, however, are “static.” They are limited to the lost economic value of *existing* technologies, businesses, and services, as measured by the higher quality and lower prices that consumers would enjoy today if spectrum were being used more productively. They do not even attempt to measure the lost innovation from poor spectrum allocation. Each day of misallocated spectrum delays the economic value of *future* technologies, *future* businesses that could use those technologies, and *future* services based on those technologies and business models. The FCC has noted the importance of spectrum to innovation.²⁴ No good estimates of the innovation losses from poor spectrum allocation are available, but they are probably greater than the static losses. Lost innovation from poor allocation of spectrum can be divided into three types:

■ **Lost market innovations**—Spectrum markets in the United States are remarkably simple and lacking in the wide range and subtle gradation of options routinely available in competitive markets. If a business wants to lease a warehouse, office, or parcel of land in almost any community in America, a robust market is available to meet that demand on negotiable terms and conditions. If the same business wants to lease one MHz of spectrum in the same community, a spectrum market is rarely available. The very structure of the spectrum markets facing wireless service providers would evolve substantially under a system of liberal spectrum use and exchange. For example, real-time spot and contract markets could develop for wide swaths of spectrum or for narrow niches of spectrum that vary by geography, time, and frequency.

■ **Lost transaction innovations**—Spectrum transactions in the United States are also strikingly underdeveloped and unspecialized. Although the FCC has promoted “secondary market” spectrum transactions in order to reduce the costs and delays of government

reviews, the use of these transactions has been limited by the Commission's own inflexible restrictions on spectrum use. The owner of a standard office building can use all of it, or can lease or sell some or all of it, under a multitude of terms, conditions, and configurations, to a variety of other users with differing needs and purposes. With Open Spectrum, spectrum transactions would become similarly variegated and responsive. Broadcasters, for example, might lease parts of their spectrum during various times of day, or combine transmissions in one 6-MHz channel while leasing other channels.

■ **Lost product and service innovations**—The FCC's spectrum use categories inevitably reflect the technologies and market conditions that existed years or decades ago when the categories were established. That limits the potential of today's innovators to combine spectrum resources with product and service designs in new and imaginative ways. Open Spectrum would open up many new pathways for innovation in wireless products and services. Because spectrum regulation follows national boundaries, and because the United States is in a position to substantially improve its spectrum allocation, America could become the test market for product and service innovations with flexibly allocated spectrum.

While it is difficult to apply a specific economic value to each of these types of innovation, each has substantial value, and each in turn enhances the value of the others.

The wireless industry has been a source of substantial growth and innovation.

Once regulators allowed the wireless industry to develop, it grew much faster than the rest of the economy.²⁵ Wireless devices that we take for granted—laptops, smartphones, and tablets, to name a few—did not exist twenty years ago, and would not exist in their current form had spectrum not been made available. Innovations

surrounding these and other products have created entire industries unimaginable just a few years ago.

Not all spectrum is equally useful for all applications. Spectrum below 3 GHz has the best characteristics for current and anticipated mobile cellular applications such as mobile broadband. Many economic studies have concluded that more broadband availability and adoption leads to greater economic growth.²⁶ Yet the majority of spectrum below 3GHz is not available for mobile cellular applications at all! Some of it is allocated to federal purposes such as defense radars and navigation; some is splintered, with a variety of users. The biggest block of underutilized spectrum below 3 GHz is the broadcast television band with approximately 300 MHz. Although the broadcast industry uses this spectrum profitably, it would in many instances be even more profitably used for other purposes, such as mobile broadband services.

In the 1980s, when commercial wireless mobile services were first widely offered, the technology was new and unfamiliar. Prices were relatively high, limiting the market to business users and the well-heeled. Wireless services were initially available only in limited markets in the United States, Western Europe, Japan, and a few other countries.

Much of the innovation in developing wireless technologies, network equipment, and handsets in the decades leading up to the 1980s was therefore conducted in the United States, Europe, and Japan.²⁷ As recently as 2000, most of the manufacturing for wireless technology and most wireless customers were located in the same areas.

American firms still have a major, indeed disproportionate role in the global wireless markets. From network equipment manufacturers (e.g., Cisco, Qualcomm) to handset manufacturers (Apple) to wireless software (Apple, Google, and Microsoft) to online wireless services (Google, Amazon, Facebook, Twitter), American companies play a major role in wireless innovation.

But many of the previous natural advantages for U.S. wireless innovation are now fading. Markets for wireless technologies are international. From handsets to network equipment, manufacturers sell to global markets. Wireless software engineers and applications developers also sell to a global market. While many wireless engineers remain in the United States, many more are abroad, particularly in Asia. The vast majority of wireless equipment manufacturing, even by American companies, is done abroad, and the value of U.S. communications equipment manufacturing peaked in 1997 and has gradually declined since then.²⁸ Wireless usage is now nearly globally ubiquitous, following population patterns. By some measures, the most advanced wireless networks and wireless services are based abroad.

Increasing demand confronts an inflexible supply of spectrum in the United States.

As the FCC has noted, the demand for spectrum for mobile broadband purposes has been growing dramatically in recent years.²⁹ Several recent transactions in the wireless industry have been premised on rationalizing spectrum holdings to meet increasing demand. Many wireless companies would eagerly purchase more spectrum if it were available.

The mismatch between expanding demand and static supply has given rise to terms in the trade and popular press such as “spectrum scarcity” and “spectrum shortage.”³⁰ Students of economics learn that “shortage” and “scarcity” usually are the artifacts of unanticipated supply disruptions or artificial price controls. In a market in which sellers can freely sell to buyers and prices are not regulated, prices will clear markets such that demand equals supply without “shortages” or “scarcity.” Where those terms are commonly and persistently used, markets are not working well. The popularity of these terms reveals the shortcomings of our spectrum markets.



Practically all bands of spectrum in the United States suffer from poor allocation. Even where technology would permit better uses of spectrum, government rules delay and discourage the improvements. Among the many instances of spectrum misallocation, broadcast television has received the most public attention. This is in part because the broadcast television band is large and has substantial market value. Additionally, many broadcast licensees would be willing to sell their licenses for other purposes.

Congress and the President have noticed the importance of broadcast spectrum.

Congress has attempted to address the misallocation of broadcast spectrum. In early 2012, it passed, and President Obama signed a law that, among other things, will require the FCC to do the following by 2022:³¹

- conduct a reverse auction to determine the amount of compensation that broadcast television licensees would accept in return for voluntarily relinquishing some or all of their broadcast television spectrum usage rights;³²
- reallocate such portions of the purchased broadcast spectrum as the Commission determines should be used for other purposes;³³ and
- conduct a forward auction in which the Commission assigns licenses for use of the spectrum that it reallocates.³⁴

Although the statute does not specify the purpose of reallocating some portion of the television broadcast band, it is widely assumed to be the release of additional spectrum for mobile broadband services. By statute, the FCC auctions do not need to be completed until fiscal year 2022.³⁵ Actual commencement of new mobile broadband services would not take place until several years after the auctions.

The purposes of the broadcast television spectrum auctions are generally recognized as the following:

- reallocate a portion of the broadcast television spectrum for mobile broadband services while compensating those incumbent broadcasters who would vacate their licenses through a reverse auction;³⁶
- generate sufficient auction revenue to pay for the reverse auction and compensation for broadcasters;³⁷
- generate \$7 billion of further auction revenue for public safety purposes;³⁸ and
- generate additional auction revenue for deficit reduction.³⁹

The FCC has assigned itself the role of exclusive agent for broadcast spectrum and proposed complicated rules that are likely unworkable.

The statutory language authorizing the FCC auctions for the broadcast spectrum easily fits on 6 pages.⁴⁰ It does not require complicated auctions or complicated rules. The FCC could have lawfully proposed simple rules for simple auctions. Instead, the Commission has proposed rules for an extraordinarily complicated set of auctions in a 205-page document.⁴¹ Final rules will not be issued soon, and the auctions themselves are years away.

The FCC's proposed approach has many problems, which mostly stem from the Commission's establishing itself as the exclusive agent for both buyers and sellers of broadcast licenses. No one can re-purpose broadcast licenses without selling them to the FCC, and no one can purchase rights to spectrum previously assigned as broadcast licenses without purchasing those rights through the FCC. In no other market does the federal government—or anyone else—place itself in the role of market maker and exclusive agent for *all parties on all sides of every transaction* between sellers and buyers. In the history of modern commerce, such a role for a party, either private or governmental, has no precedent. The absence of a precedent is a strong signal that such a governmental role likely will not work.

The specific problems with the FCC's proposed rules include the following:

■ The proposed auction structure is unnecessarily complex. Under these circumstances, potential buyers and sellers will have difficulties making plans for the auctions. The statute permits, but does not require, complexity.

■ Even if the proposed auction process were not unnecessarily complex and would not cause unnecessary delays, it would be a bad structure for *all* potential sellers of spectrum. It denies sellers the ability to sell their spectrum *today* to willing buyers who would use the spectrum for a non-broadcast purpose. Potential sellers must instead wait years for the FCC to complete its rules, implement an auction, and clear the spectrum after the auction.

■ Even if the proposed auction process were not unnecessarily complex, it would cause unnecessary delays. It will take many years, perhaps ten or more, to complete the auction and reallocation process. The statute permits, but does not require, lengthy delays.

■ Even if the proposed auction process were not unnecessarily complex and would not cause unnecessary delays, and even if it were not a bad structure for *all* potential sellers of spectrum, it would be a bad structure for potential sellers who will not be able to sell their spectrum under it. The proposed auction structure condemns the vast majority of broadcasters to no future but television broadcasting. Only broadcast licensees in "Designated Market Areas" (DMAs) where the FCC would conduct a reverse auction would actually have an opportunity to participate in the auction. Under many scenarios, most DMAs have enough dark (unassigned) licenses to conduct a forward auction without a reverse auction. Broadcasters in markets without a reverse auction who would nonetheless prefer to cease broadcasting in return for compensation would not be able to do so. Even in those markets with reverse auctions, broadcasters who were unsuccessful in the reverse auction but who would nonetheless prefer to cease broadcasting in return for compensation would not be able to do so.

■ Moreover, the FCC proposal provides no path to selling spectrum for broadcasters who today wish to continue broadcasting, but who

ten years from now, soon after the auction, decide they would prefer to sell their spectrum or use it for another purpose. The proposed rules contemplate a single auction. Those broadcast licensees who miss the auction have no specific subsequent recourse.

■ Even if the proposed auction process were not unnecessarily complex and would not cause unnecessary delays, and even if it were not a bad structure for *any* potential sellers of spectrum, it would be a bad structure for *all* potential buyers of spectrum. Many of them would be willing to buy spectrum today, but under the proposed rules, they would not be able *today* to purchase spectrum from willing sellers. Potential buyers would instead have to wait years for the FCC to complete its rules, implement an auction, and clear the spectrum after the auction.

■ Even if the proposed auction process were not unnecessarily complex and would not cause unnecessary delays, and even if it were not a bad structure for *any* potential sellers of spectrum and for *all* potential buyers of spectrum, it would still be a bad structure for *some* potential buyers of spectrum. Those potential buyers would wait for years and go to auction, and by definition, some of them would be unsuccessful because they would bid less than those who succeeded. However, even some of the lower bids might be greater than the price at which some broadcast licensees would be willing to sell their spectrum if they were allowed to do so in the auction.

■ Moreover, the FCC proposal provides no path to buying spectrum for potential buyers who today place a low value on buying spectrum or participating in the auction, but who ten years from now, soon after the auction, decide they would prefer to buy spectrum, even at a price higher than that obtained in the auction. The proposed rules contemplate a single auction, and potential buyers who miss it would have no specific subsequent recourse.

■ Even if the above conditions did not hold, making a federal agency the exclusive middleman in an exchange of an asset between one private party and another is fraught with peril. It is a transaction structure with no common precedent, and the FCC proposes complicated auction methods that may ultimately prove unsuccessful.

■ Even if the auction processes work, the government’s standing between two private parties in an exchange raises issues similar to those in the Supreme Court’s *Kelo* decision.⁴²

It is possible, given enough time and effort, and under fortuitous circumstances, that the FCC’s proposal could eventually lead to some reallocation of spectrum that better reflects market sensibilities than the current allocation. But writing the rules, conducting the auction, and enforcing the results will take years. The outcome is far from certain. There is a much better solution.

The FCC should adopt a simpler, more efficient solution: allow spectrum to be used flexibly.

Consistent with law, the FCC could solve all of the problems we have examined through Open Spectrum. This approach is authorized by the Commission’s current statutory authority and consistent with the main purposes of the 2012 auction statute, but would be dramatically faster and more effective than its current auction plans. Here is how it would work:

■ Allow flexible use for most spectrum, including broadcast spectrum.

The FCC allocates spectrum for specific uses in specific bands. Under Commission rules, licensees in bands allocated for satellite services must offer satellite services, and licensees in the television broadcast spectrum must engage in broadcasting television. Why the rigidity? In recent years, the FCC has increasingly granted greater flexibility of use to licensees, such as mobile satellite service providers who wish to use spectrum for some terrestrial purposes.⁴³ The presumption should be that spectrum can be used for any purpose as long as it does not interfere with neighboring licensees. Spectrum is allocated primarily by rule rather than statute, and the rigidities that deny licensees the ability to offer other services is entirely a regulatory

construct. The Commission has the authority to grant flexibility in the spectrum bands that it regulates.⁴⁴ It has chosen to exercise that authority in some, but not all bands. It could use that authority more completely.

■ Allow broadcasters and other licensees to offer other services or sell part or all of their licenses to other entities to offer other services.

These transactions could happen as soon as the FCC writes rules to allow for flexible use of spectrum, likely years before it could conduct an auction. Broadcasters in every market, not just those the FCC selected for a reverse auction, could sell their spectrum. Any licensee who wanted to sell its spectrum could do so; no licensee would be left behind.

■ Conduct the forward auction for the dark licenses.

Most of the geography and spectrum in the broadcast band is not directly occupied by full-power broadcast licensees. Consistent with the statute, the FCC would still conduct the forward auction for the unused and dark licenses. Such an auction would raise substantial sums of money, quite likely more than the \$7 billion guaranteed for public safety. But the auction would not need to wait for the return of broadcast licenses; it could be a simple auction subject to FCC rules. The simpler forward auction could be conducted much sooner than the FCC's proposed auction. There are many options for the forward auction. One would be based on an "overlay" model where auction winners would acquire exclusive rights to purchase the spectrum associated with broadcast licenses in a particular band.⁴⁵ Another would preserve multiple buyers for broadcast licenses and repack remaining broadcasters into contiguous channels once every two years.⁴⁶

■ Conduct the reverse auction.

Most licensees would get a larger payment (and sooner) by selling their spectrum in a competitive market rather than the reverse auction. But as required by statute, after the forward auction, the FCC could still conduct the reverse auction. The statute requires no particular size for a reverse auction, and the FCC could tailor it to those

licensees, if any, who want only to sell their spectrum to the federal government. The FCC should oblige them. It would likely be a formality, as any licensee that wanted to sell its spectrum could already have done so by a direct transaction with a buyer.

The Open Spectrum proposal is superior to the currently proposed FCC rules for many reasons. Here are just a few.

Open Spectrum is far simpler than the proposed FCC rules.

It would not take 5 pages, much less 205, to propose rules to allow flexible use of spectrum. There would be no need for complicated and novel auction procedures. Everyone could understand the new rules without an army of lawyers and economists to interpret them.

How much does America value simpler rules? The FCC, in compliance with the Regulatory Flexibility Act, should provide an estimate of the administrative cost of its auction rules. Although the Commission has a document labeled an “Initial Regulatory Flexibility Act Analysis,”⁴⁷ it does not present any reasonable accounting of expected actual or potential costs.⁴⁸ The actual costs are not limited to the administrative costs of businesses that successfully buy or sell spectrum but must hire lawyers and economists to comply with the new rules. The larger and much more troubling costs include the following:

- the administrative costs associated with hiring professional advisers to interpret and comment on the proposed rules;
- the administrative costs associated with participating in the various proposed auctions for both buyers and sellers;
- the opportunity costs for the countless businesses and individuals that, upon reviewing the complex rules, despair of even trying to participate;
- the opportunity costs of forgone competition from new businesses that will not develop without new spectrum;

- the opportunity costs of time for both buyers and sellers for the inherent delays between the publishing of the proposed rules and the ultimate date when licenses might be transferred and licensees paid;
- the opportunity costs of forgone innovation that will not be recognized during the years when more spectrum is not made available to the market;
- the opportunity costs of forgone economic activity for the American economy during the years when more spectrum is not made available to the market; and
- the disproportionate concentration of the above costs on small entities.

Open Spectrum gets more spectrum in the market.

The FCC's proposed spectrum auction would affect only licenses within the broadcast band that were acquired in the reverse auction. Open Spectrum would affect many thousands of additional licenses, both within and beyond the broadcast bands. The benefits of spectrum flexibility, which the Commission recognized in granting mobile satellite service providers the freedom to use spectrum for terrestrial links, would be available to practically all licensees, rather than only a favored few.

No one knows exactly how much spectrum the FCC plans to make available under its auction proposal. Estimates range from 90–120 MHz nationwide. Under the Open Spectrum, the market, rather than Washington, would decide how much additional spectrum would be made available for mobile applications. It might be more than 120 MHz in some markets and less in others. It might vary by time of day, geography, and frequency, but it would ultimately be determined by the willingness of firms to pay for the additional spectrum, based on their estimates of consumer demand.

In addition, under Open Spectrum, every broadcaster within the broadcast band, regardless of DMA, would have an opportunity to develop or sell some or all of its spectrum for commercial development. Under the FCC proposal, only broadcast licensees in DMAs that would have reverse auctions would have an opportunity to sell their licenses, and

not every broadcaster would be successful in selling its licenses in the auction. In addition, many broadcast licensees who would be interested in selling some or all of their spectrum would be unsuccessful because of FCC decisions. Under Open Spectrum, no broadcast licensee interested in selling spectrum is prevented from doing so.

How much does America value getting more spectrum in the market? Economists have estimated the market value of the broadcast spectrum put to other uses at more than \$100 billion annually. Current FCC rules capture none of this value. The FCC auction proposal would shift only part of the broadcast band to other purposes. Open Spectrum would free much more spectrum, both inside and outside the broadcast band, for potential redeployment to other, more valuable uses.

Open Spectrum gets spectrum in the market much sooner.

One of the more startling provisions in the spectrum statute is that the broadcast spectrum auctions must be completed only by the end of fiscal year 2022.⁴⁹ The statute contains no deadline for putting spectrum to commercial use, presumably well after the auctions are completed. For most individuals and businesses, a decade or more is a long time, practically an eternity. Deferring the benefits of improved spectrum allocation for such a long time is egregiously wasteful and entirely unnecessary.

Zoning restrictions could be removed and more flexibility provided quickly. Once these restrictions were removed, broadcast and other spectrum could be put to different uses. Of course, within the broadcast band, care must be taken to avoid interference between broadcasters and other purposes. But avoiding interference is already standard practice in the wireless industry, and the FCC could facilitate that process by expediting the voluntary relocation of licensees to reduce interference. Some observers note that no specific government action would be necessary with an overlay, as market forces would take care of most, if not all, interference issues.⁵⁰

How much sooner than auctions would Open Spectrum get spectrum to the commercial market? The FCC could implement it within a year. Moreover, under the Open Spectrum proposal, allowing more spectrum to come to market would not be a one-time event like an auction. Instead, spectrum licensees could react at any time, either before or after a proposed auction, to bring competitively effective spectrum to market. The timing of spectrum reallocation would be governed by decentralized, variegated

market procedures, with opportunities for continuous learning and improvement that the FCC auctions would suppress.

Open Spectrum yields a competitive price for spectrum.

As noted above, the current markets for spectrum in the United States are frequently characterized by “scarcity” and “shortage.” The reason is not price regulation, but rather regulatory impediments to supply. Prices for potential users of spectrum are higher than they would be in competitive markets without artificial supply restrictions, where numerous licensees could offer some or all of their spectrum in response to changing demand. Prices are higher because much spectrum is artificially prevented from becoming available to users, and even when spectrum is made available, the associated transaction costs are unusually high.

Because the Open Spectrum proposal would allow licensees to make spectrum freely available in spectrum markets, not only would more spectrum come to market more expeditiously than under the current regulatory system or the FCC’s proposal, but the resulting price of spectrum would be closer to the competitive price.

The producer and consumer surpluses associated with lower spectrum prices are substantial. Current FCC rules capture none of this value, and the FCC-proposed auction rules would capture little of it.

Open Spectrum avoids the exclusive agent problem.

Consumers and business firms like to sell and shop in competitive markets. No one would prefer to shop in a town with only one grocery store or buy and sell a house in a community with only one real estate broker. Yet the FCC’s auction proposal is exactly that: the equivalent of a real estate market with only one agent serving all

sellers and buyers. No one knows exactly whose interest such a real estate broker would represent, except its own.

A market with only one supplier is a monopoly. Under its broadcast forward auction proposal, the FCC is setting itself up as a monopoly supplier of new spectrum in the commercial market. Only the terms and conditions offered by the Commission would be available to potential buyers. Current licensees, particularly broadcast licensees, would not be allowed to use spectrum for other purposes or sell it to others for development in competition with the FCC's exclusive selling arrangement.

In contrast, under Open Spectrum, multiple sellers in a market would compete with one another to provide a product at lower prices and higher quality. Multiple sellers would also compete on timing and terms and conditions of transactions.

In a similar manner, the FCC, in its reverse auction proposal, is setting itself up as the exclusive buyer of spectrum for non-broadcast purposes. Dozens of other entities may be interested in purchasing spectrum for non-broadcast purposes, but they will not be allowed to compete with the FCC in purchasing spectrum directly from licensees. In an open market, multiple buyers compete with one another to purchase products at higher prices and higher quality and also compete on timing, terms, and conditions of transactions. The FCC's reverse auction plan allows for no other direct buyers and forces potential sellers to accept the timing, terms, and conditions offered by the only buyer in the market.

Under Open Spectrum, anyone may purchase licenses directly from broadcast licensees. These multiple buyers would compete on price and quality and on the timing, terms, and conditions of transactions.

In addition to setting itself up in one auction as the sole buyer and in another auction as the sole seller, the FCC also makes itself the exclusive transaction agent between one set of private sellers and another set of private buyers. There is substantial precedent for the government to purchase private assets for a public use under the doctrine of eminent domain—but that is not the purpose of the FCC proposal. There is also substantial precedent for the government to use auctions to transfer an asset such as a government security or a grazing right from the public sector to a private user—but that is not the exclusive purpose of the FCC proposal. There is no good precedent for the government to place itself between willing private sellers and willing private buyers. The potentially corrupt outcomes from such a situation were widely discussed in the public comments surrounding *Kelo*.⁵¹ All of these potentially bad outcomes are avoidable.

Open Spectrum gets the government out of micromanaging markets.

Even if the FCC proposal were simple, able to get more spectrum to market sooner, and free of the exclusive-agency problems, it would still leave America with heavy and unnecessary government regimentation of spectrum usage and transactions. The Open Spectrum proposal addresses the deficiencies of continuing spectrum micro-management directly.

Open Spectrum allows for greater market and transaction innovation.

In a static view of spectrum markets, additional spectrum brought to market sooner could be worth hundreds of billions of dollars annually. But many markets are driven by technology, and wireless markets are characterized by particularly rapid technological changes.

Open Spectrum would facilitate innovation in the structure of spectrum markets. It is impossible to describe what wireless markets in America would look like with substantially more spectrum, both vast swaths of contiguous spectrum and small bits of spectrum divided by geography, time, or frequency. Spectrum would flow to its highest-valued use, and businesses with new and innovative business models would be willing to pay for more spectrum.

Open Spectrum would also facilitate novel and innovative transactions for spectrum. Small businesses and even government agencies would see value in making their spectrum available in more flexible, dynamic markets. For example, Open Spectrum might enable contracts making spectrum available, if certain market conditions were met, in a real-time spectrum exchange market. Neither the real-time spectrum exchange nor

sophisticated contracts for spectrum on the exchange exists today. Open Spectrum and more efficient allocation of spectrum would allow for all of this.

Over the past few decades, much of the innovation that has enhanced the lives of Americans and propelled the competitiveness of American businesses has been associated with new wireless technology. From scanning devices to cell phones, from GPS to wireless Internet, wireless innovation marches on. There are no good estimates of the value of wireless spectrum with rapidly changing technology.

Making spectrum available in flexible markets can only facilitate wireless product and service innovation. Businesses would be able to employ spectrum in ways not currently possible. Today, American spectrum allocation and spectrum rights are little different from and no better than those in many other countries. Under Open Spectrum, the United States would have the most flexible and dynamic spectrum allocation in the world, and engineers and entrepreneurs would flock to America to use this spectrum as the test bed for new services that can only be imagined now.

Open Spectrum will help the American economy and the federal budget.

Some people think that a primary purpose of the FCC broadcast spectrum auctions is to raise revenues for the federal treasury. In this view, the current FCC proposals may be regarded as superior to Open Spectrum because the forward auction would include some currently used broadcast licenses that would be privately purchased under Open Spectrum.

This view is incorrect. First, even with Open Spectrum, the FCC would still conduct a forward auction of the licenses it currently holds. As noted above, such an auction would generate substantial receipts, likely more than the \$7 billion earmarked for public safety. Second, because the FCC would not have to compensate broadcasters to vacate part or all of their licenses, the Open Spectrum proposal might actually net nearly as much in auction receipts as the FCC proposal, if not more. Third, with Open Spectrum, the forward auction could be conducted sooner, and receipts collected sooner, than under the FCC proposals.⁵²

Fourth, spectrum would be put to higher-valued uses sooner and more efficiently with

Open Spectrum, leading to greater economic activity and therefore higher federal tax receipts. Fifth, Open Spectrum does not rely on a cumbersome and unprecedented reverse auction, which may lead to unpredictable and unsatisfactory results. Stated slightly differently, proponents of the FCC proposal must claim that Open Spectrum would have fewer economic benefits than the discounted value of, at most, a few extra billion dollars of hoped-for auction receipts several years from now. Such a claim is wrong.

Conclusion

The Open Spectrum proposal offers far greater opportunities for innovation in spectrum markets, spectrum transactions, and wireless products and services than either the current FCC rules or the proposed broadcast auction rules. The economic value of all of these benefits of a more economically rational approach to spectrum for the wireless world is substantially greater than any possible benefits of the FCC's proposed rules to auction broadcast spectrum.

Table 1 presents a summary of Open Spectrum's advantages over the FCC's proposed rules for a broadcast spectrum auction. Many different criteria are listed in the table, and for each criterion, the Open Spectrum proposal is preferable to the FCC's auction proposal.

Table 1. Summary of Open Spectrum’s advantages

Criteria	Current FCC rules combined with FCC auction proposal	Open Spectrum proposal
Complexity of rules for spectrum use	Complex	Simple
Amount of additional spectrum available for new mobile services	Perhaps 90–120 MHz of broadcast band	Almost certainly substantially more spectrum than FCC proposal, both inside and outside broadcast band
Timing for additional mobile spectrum	Years after completion of auctions	As soon as rules are completed
Price of spectrum relative to competitive price	Lower than current system but higher than competitive market	Competitive price once flexibility in place
Owners of spectrum rights make more available to competing uses as price rises	Slightly more response	Fully responsive to prices
FCC as exclusive buyer of spectrum	Yes	No
FCC as exclusive seller of spectrum	Yes	No
FCC as micromanager of spectrum use	No	Yes
Opportunities for spectrum market innovations	No	Yes
Opportunities for spectrum transaction innovations	No	Yes
Opportunities for spectrum product and service innovations	Some	Most
Increased economic value relative to current system	Once spectrum is put to new use, perhaps a few hundred billion dollars annually of combined consumer and producer surplus	With more spectrum put to use more quickly and fully responsive market conditions, substantially greater consumer and producer surplus, both initially and in subsequent years

Endnotes

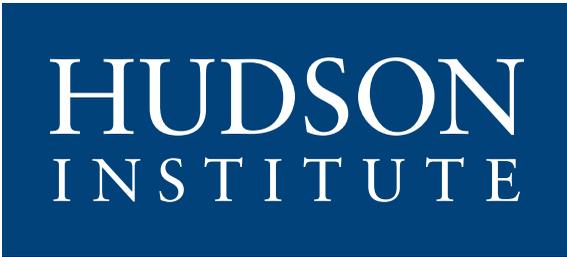
1. I wish to thank Tom Hazlett and Christopher DeMuth for valuable comments on earlier drafts of this paper, and participants at a February 2013 workshop at the Hudson Institute for their valuable comments on a later draft. The remaining errors are my own. The views expressed in the paper are mine alone.
2. The consumer surplus generated by additional bandwidth used by the carriers has been found to exceed, on an annual basis, ten times the producers' surplus, which in turn is the amount carriers would be willing to bid at auction for spectrum licenses. See, e.g., Thomas W. Hazlett, Roberto E. Muñoz, and Diego B. Avanzini, "What Really Matters in Spectrum Allocation Design," 10 *Nw. J. Tech. & Intell. Prop.* 93 (2012), <http://scholarlycommons.law.northwestern.edu/njtip/vol10/iss3/2>; Thomas W. Hazlett, "Optimal Abolition of FCC Spectrum Allocation," 22 *J. Econ. Persp.* 103 (2008), <http://arlingtoneconomics.com/studies/optimal-abolition-of-fcc-spectrum-allocation.pdf>; Thomas W. Hazlett and Roberto E. Muñoz, "A Welfare Analysis of Spectrum Allocation Policies," 40 *Rand J. Econ.* 424 (2009), http://mason.gmu.edu/~thazlett/pubs/Hazlett_Munoz.RandJournalofEconomics.pdf; and Thomas W. Hazlett, "Unleashing the DTV Band: A Proposal for an Overlay Auction," comment submitted to the FCC in GN Docket 09-47, GN Docket 09-51, and GN Docket 09-137, December 18, 2009.
3. The Congressional Budget Office estimates net auction receipts of approximately \$15 billion over a ten-year period ending in fiscal year 2022. See CBO letter from Douglas W. Elmendorf to Dave Camp, February 16, 2012, at http://www.cbo.gov/sites/default/files/cbofiles/attachments/hr3630_2.pdf.
4. For a history of the federal assertion of ownership, see Thomas W. Hazlett, "The Rationality of U.S. Regulation of the Broadcast Spectrum," 33 *J. Law & Econ.* 133 (1990), <http://mason.gmu.edu/~thazlett/pubs/Rationality%20of%20U.S.%20Regulation.pdf>.
5. Leo Herzel, "'Public Interest' and the Market in Color Television Regulation," 18 *U. Chi. L. Rev.* 802 (1951), <http://www.jstor.org/stable/1598016>.
6. Ronald H. Coase, "The Federal Communications Commission," 2 *J. Law & Econ.* 1 (1959), <http://www.eecs.berkeley.edu/~dtse/coase.pdf>; see also various publications of Thomas W. Hazlett.
7. Thomas W. Hazlett, "Optimal Abolition of FCC Spectrum Allocation," note 2, at table 1.
8. See FCC, WT Docket 03-66, "Report and Order and Further Notice of Proposed Rulemaking," released July 29, 2004.
9. See FCC, WT Docket 07-293, "Order on Reconsideration," released October 17, 2012.
10. See FCC, SkyTerra, IB Docket 08-184, "Memorandum Opinion and Order and Declaratory Ruling," released March 26, 2010.
11. See FCC, ET Docket 10-142, Service Rules for Advanced Wireless Services in the 2000–2020 MHz and 2180–2200 MHz Bands, "Report and Order and Order of Proposed Modification," released December 17, 2012.

12. *Id.*
13. The substantial economic literature on transactions and related costs has been developed by, among others, Ronald H. Coase, Armen Alchian, and Oliver Williamson. Thomas W. Hazlett has particularly examined the specific application of transaction cost analysis to spectrum regulation in the United States, particularly with respect to broadcast spectrum.
14. The FCC does allow some secondary market transactions in certain bands of spectrum.
15. *Omnibus Budget Reconciliation Act of 1993*, Pub. L. No. 103-66, 103rd Cong., 1st Sess. (August 10, 1993).
16. *Balanced Budget Act of 1997*, Pub. L. No. 105-33, 105th Cong., 1st Sess. (August 5, 1997).
17. Ronald H. Coase (1959) suggested that property rights for spectrum could resolve interference concerns. He subsequently elaborated on the point in “The Problem of Social Cost,” 3 *J. Law & Econ.* 1 (1960), <http://www2.econ.iastate.edu/classes/tsc220/hallam/Coase.pdf>. Prof. Christopher Yoo has an insightful analysis of interference and spectrum rights. See Christopher Yoo, “Beyond Coase: Emerging Technologies and Property Theories,” 160 *U. Pa. L. Rev.* 2189 (2012), [https://www.law.upenn.edu/journals/lawreview/articles/volume160/issue7/Yoo160U.Pa.L.Rev.2189\(2012\).pdf](https://www.law.upenn.edu/journals/lawreview/articles/volume160/issue7/Yoo160U.Pa.L.Rev.2189(2012).pdf).
18. See FCC Working Group LightSquared and the United States Global Positioning System Industry Council, “Final Report,” released June 30, 2011, <http://www.saveourgps.org/interference-studies.aspx>.
19. See FCC Docket 07-293, “In the Matter of Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310–2360 MHz Frequency Band.”
20. See FCC Docket 06-49, “In the Matter of Amendment of the Commission’s Part 90 Rules in the 904–909 and 919.75–928 MHz Bands.”
21. Jeffrey H. Rohlf, Charles L. Jackson, and Tracey E. Kelly, “Estimate of the Loss to the United States Caused by the FCC’s Delay in Licensing Cellular Telecommunications” (National Economic Research Associates, Inc., November 8, 1991, revised), <http://www.jacksons.net/EstimateofTheLossFromCellularDelay.pdf>. See also Thomas W. Hazlett, “Optimal Abolition of FCC Spectrum Allocation,” note 2 above.
22. Harold Furchtgott-Roth, *A Tough Act to Follow: The Telecommunications Act of 1996 and the Separation of Powers Failure* (2006), pp. 24–25.
23. The consumer surplus generated by additional bandwidth used by the carriers has been found to exceed, on an annual basis, ten times the producers’ surplus, which in turn is the amount carriers would be willing to bid at auction for spectrum licenses. See, e.g., Hazlett, “Optimal Abolition of FCC Spectrum Allocation,” note 2 above; Hazlett and Muñoz, “A Welfare Analysis of Spectrum Allocation Policies,” note 2 above; and Hazlett, “Unleashing the DTV Band: A Proposal for an Overlay Auction,” note 2 above.
24. See Chapter 5 in FCC, *Connecting America: The National Broadband Plan* (2010), www.broadband.gov.
25. Between 1992 and 2007, the wireless industry and related industries grew much faster than the

- remainder of the American economy. See Harold Furchtgott-Roth, “The Wireless Sector: A Key to Economic Growth in America” (prepared for CTIA-The Wireless Association, January 2009).
26. See, e.g., Nina Czernich, Oliver Falck, Tobias Kretschmer, and Ludger Woessmann, “Broadband Infrastructure and Economic Growth,” 121 *Econ. J.* 505 (2011), http://www.isto.bwl.uni-muenchen.de/download/forschung/ictcm/czernich_et_al.pdf.
27. See, e.g., Dave Mock, *The Qualcomm Equation: How a Fledgling Telecom Company Forged a New Path to Big Profits and Market Dominance* (2005).
28. U.S. communications equipment manufacturing had \$82 billion in value of shipments in 1997. See U.S. Census Bureau, 1997 Economic Census, Manufacturing, table 1-1d, at <http://www.census.gov/prod/ec97/97m31s-gs.pdf>. By 2010, this value had declined to \$47 billion in nominal terms (in real terms, the decline is greater). See http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ASM_2010_31GS101&prodType=table.
29. Chapter 5 in FCC, *Connecting America: The National Broadband Plan*, note 24 above.
30. “Spectrum scarcity” yielded 49,000 hits and “spectrum shortage” yielded 173,000 hits in a Google search on June 3, 2013.
31. *Middle Class Tax Relief and Job Creation Act of 2012*, Pub. L. No. 112-96, 112th Cong., 2nd Sess. (February 22, 2012). See particularly Title VI.
32. *Id.* at Section 6403(a).
33. *Id.* at Section 6403(b).
34. *Id.* at Section 6403(c).
35. *Id.* at Sections 6402, 6405.
36. *Id.* at Section 6403.
37. *Id.*
38. *Id.* at Section 6413.
39. *Id.*
40. *Id.* at Title VI, Subtitle D.
41. FCC Docket 12-268, Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, “Notice of Proposed Rulemaking,” released October 2, 2012.
42. In *Kelo v. City of New London*, 545 U.S. 469 (2005), the Court held that government “eminent domain” condemnation of property, for purposes of transferring the property to others for private development, was constitutional under the Takings Clause of the Fifth Amendment. The decision was close (5-4), and it has proven highly controversial, both legally and politically. The FCC’s proposed spectrum auction rules parallel the circumstances of *Kelo* in many respects—including the government’s making itself an exclusive agent for transferring property from one private party to another, with substantial benefits to the government from its position as monopoly agent; the government’s exercising substantial discretion to determine which parties obtain the property; and the puzzle of why the government should be brokering private commercial transactions in the first place. Although FCC spectrum licenses are not private property in the sense of real estate, they have substantial value, have induced substantial, essential private investments in physical property, and are

traded in secondary markets. The FCC's proposed auction rules anticipate that it will pay many billions of dollars to acquire spectrum rights from some licensees and collect many billions from reselling them.

43. FCC IB Docket No. 01-185, Flexibility for Delivery of Communications by Mobile Satellite Service Providers, "Memorandum Opinion and Order and Second Order on Reconsideration," released February 25, 2005.
44. The FCC regulates spectrum for commercial and public safety uses. It does not regulate spectrum allocated to the federal government. Many federal agencies (e.g., DOD, NASA, NOAA) have primary use of some bands of spectrum.
45. Hazlett, "Unleashing the DTV Band: A Proposal for an Overlay Auction," note 2 above.
46. Broadcast spectrum includes a combination of spectrum assigned to broadcasters with fully protected rights and other spectrum that is either unassigned or assigned to broadcasters on a short-term basis without long-term rights. "Repacking" spectrum refers to moving protected broadcasters in each geographic area into contiguous channels and freeing up the other spectrum for auction. Because moving channel locations takes time, careful planning, and money, repacking has become one of the more controversial aspects of the FCC's reverse auction proposal. The FCC can, however, repack spectrum independent of the proposed reverse auction and its short timelines.
47. FCC Docket 12-268, Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, "Notice of Proposed Rulemaking," note 41 above.
48. See Harold Furchtgott-Roth, Testimony before the U.S. House of Representatives, Judiciary Committee, Subcommittee on Courts, Commercial and Administrative Law, "Cost-Justifying Regulations: Protecting Jobs and the Economy by Presidential and Judicial Review of Cost and Benefits," May 4, 2011.
49. 47 U.S.C. 1452(f)(3).
50. Hazlett, "Unleashing the DTV Band: A Proposal for an Overlay Auction," note 2 above.
51. *Kelo v. City of New London*, note 42 above.
52. The Congressional Budget Office estimates net auction receipts of approximately \$15 billion over a ten-year period ending in fiscal year 2022. See CBO letter from Elmendorf to Camp, note 3 above.



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