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Liberalizing US spectrum allocation

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Abstract

In the US, adjudication of wireless entry under the “public interest” standard protects incumbent service providers. Excess demand exists for access to radio spectrum, despite a common misperception that license auctions held by regulators are tantamount to selling spectrum. Would-be suppliers are slowed by the regulatory process. After discussing the financial tolls extracted, the author suggests a number of structural policy reforms, applicable both to the USA and perhaps spectrum markets elsewhere. These include: permissive airwave use (within emission limits implicitly defined by the license); endowing licensees with use of adjacent buffer zones; exhaustive allocation of remaining bandwidth to new applicants and streamlining the process for entrants to gain access to unoccupied bandwidth, using liability rules and post-entry dispute resolution mechanisms.

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1. The problem

Excess demand exists for access to radio spectrum (FCC 2000a, par. 11). New competitors seeking to enter wireless markets, and innovative technologies eager to test customer acceptance, champ at the bit to bid frequencies away from current employments. They are frequently willing and able to compensate those who would sacrifice today’s opportunities, but are blocked from offering tomorrow’s.

A common misperception is that license auctions held by US (or other) regulators are tantamount to selling spectrum. The rights issued by competitive bidding allow winners to provide

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particular wireless services; spectrum use is itself allocated by the Federal Communications Commission. A TV station, for instance, may not unilaterally decide to stop broadcasting TV signals and instead use the frequencies allocated to its license to transmit cellular telephone calls. The effect is to fix the price of radio spectrum at zero. When price controls create shortages, the marginal opportunity cost of the controlled substance actually *rises*. Our policies, which waste massive wireless bandwidth, make the next unit of spectrum deployed much too dear.

The system, however, is not broken; it is working precisely as designed. Adjudication of wireless entry under the “public interest” standard (adopted in the 1927 Radio Act and yet prevailing) over-protects incumbent service providers. Suppliers of rival wireless services would be much swifter to market if spectrum inputs were available for purchase. Instead, they are slowed by regulatory process. In times of dynamic economic change these barriers exact extraordinarily steep tolls.

Some point to ongoing reforms and pronounce allocation problems solved. Former FCC Chair Reed Hundt proclaimed: “We totally deregulated wireless” (Hundt, 2000, p. 98). The relaxation of some rules does inform our policy choices, but the current state of spectrum liberalization is analogous to a temporary experimental license issued to one low-power non-commercial user in a remote Alaskan village. General adaptation of a good idea is very far from complete.

As outlined in the *Comment by Thirty-seven Concerned Economists* (Thirty-seven Economists, 2001), allowing private users to determine service and technology deployments will push costs down, expand usage, and spur innovation. This will improve economic efficiency and produce an array of public goods, including those emanating from the emergence of ubiquitous communications networks.

There is little debate among economists about the net benefits of liberalization because current regulations thwart efficiency without creating off-setting social benefits. Economists familiar with the current system understand that the alternative to extant regulation is neither chaos nor monopoly. Interference between users can result in a tragedy of the commons, but alternative rules can remedy boundary disputes far more quickly and reliably than “public interest” proceedings. Existing rules, moreover, create a moral hazard for incumbents who are rewarded for raising interference complaints simply to block competition. Likewise, monopoly power can arise in either current or more liberal spectrum allocation regimes, but the status quo systematically creates market power by raising barriers to entry. By reducing those barriers while allowing traditional antitrust enforcement (by the FCC or two other federal agencies, the Department of Justice and the Federal Trade Commission) to police anti-competitive conduct, economists offer that regulation may be unambiguously improved.

Despite an economic consensus in favor of liberalization, it is not obvious how to implement such policies. While the decades-long debate over license assignment has been resolved in favor of Coase’s (1959) plan to utilize competitive bidding, a market in spectrum itself has yet to arrive. Indeed, the advent of license auctions may not be helping to open up access to airwaves, as there is some evidence that despite intense pressure from emerging New Economy industries, spectrum allocations in the auctions era are no more expeditious than during previous epochs. See Table 1.

There are three basic ways to move spectrum policy. The first is for the FCC to make better decisions. These decisions must not just be ultimately wiser, but more rapidly ultimate. Entry delayed is competition squandered. Second, the Commission can restructure processes, streamlining the procedural gauntlet entrants must brave. Third, Congress can reform the

Table 1
FCC allocation and auction duration (as of spring 2001)

Service	Docket no.	MHz	Petition or event cited as trigger	Proceedings initiated	Auction over	Total time to license (years)
IVDS	GEN 91-2	0.5	12/2/87	1/10/91 (NPRM)	7/29/94	6.7
Narrowband PCS	GEN 90-314	3	9/22/89	6/14/90 (NOI)	7/29/94	4.8
Broad. PCS A-B	GEN 90-314	60	9/22/89	6/14/90 (NOI)	3/13/95	5.5
Broad. PCS C- F	GEN 90-314	60	9/22/89	6/14/90 (NOI)	4/15/99	9.6
DBS	IB 95 168	500	12/17/80	6/1/81 (NPPRM)	1/26/96	15.1
	GEN 80-603					
DARS	GEN 90-357	25	5/18/90	(8/1/90) (NOI)	4/2/97	6.9
WCS	GEN 96-228	30	8/10/95	11/8/96 (NPRM)	4/25/97	1.6
			(NTIA Rep.)			
LMDS # 17	CC 92-297	1300	1/91	12/10/92 (NPRM)	3/25/98	7.2
LMDS # 23	CC 92-297	1300	1/91	12/10/92 (NPRM)	5/12/99	8.3
(re-auctions)						
39 GHz	ET 95-183	1400	9/9/94	12/15/95 (NPRM)	5/8/00	5.7
GWCS	ET 94-32	25	8/10/93	2/10/94 (NTIA Rep.)	Auction pending	≥7
			(OBRA)			
UHF Channels 60–69 (3G)	WT 99-168	24	1986	6/17/96	Auction	≥15
					3/6/01	
12 GHz terrestrial DBS	ET 98-206	500	1994	11/19/98	Auction pending	≥6

Source: Hazlett (2001a–c, Table 8).

regulatory system. This paper outlines ways in which all three opportunities can improve utilization of radio spectrum.

2. Permissive licenses

To implement liberalization, the regulatory reflex is to initiate a rule making to define new license rights. But the systemic problem lies in the structure of agency decision-making. Commission procedures require firms to receive permission to enter markets. These are not pro forma grants, but are complicated and idiosyncratic. Standards are not fixed in advance, but vary according to the “public interest.” Perhaps most importantly, entry decisions by the FCC are front-loaded, such that all possible effects of a change in spectrum use are fair game for discussion *ex ante* (prior to market data being generated). While entry that generates interference damage exceeding consumer gains is inefficient, established interests reliably oppose both inefficient *and* efficient entry. The front-loaded regulatory decision on entry, combined with the burden of proof placed on the entrant, leads to strategic gamesmanship, wherein incumbents have the incentive to raise countless questions and engage in procedural stratagems simply to delay competition.

Rather than explicitly constructing a market in spectrum, the preferred agency approach is to craft permissive rules that build on existing rights structures. This allows current services, and the

investments that empower them, to serve the public without disruption—an efficient and politically necessary ingredient in the transition to open markets. Atop this foundation, wireless licenses should be deregulated, turning into broad, flexible, generic spectrum rights.

Currently, standard FCC licenses regulate wireless services as “radio station authorizations.” These permits define what transmissions users can generate, the equipment used to make them, the location of such equipment, and the services they may provide. Extensive rule makings further define market structures (e.g., defining the number of competitors), channelization of allocated bandwidth, and detailed aspects of the organization licensed (for-profit, non-profit, common carrier, broadcaster, private carrier, etc.). Within this permitting process, spectrum is allocated to the license by the Commission, and cannot be reallocated by the licensee. Important elements of deregulation have made FCC licenses more permissive in recent years, allowing for more discretion on the part of the licensee. These reforms, however, have been on a case-by-case basis, releasing constraints one regulation at a time. A general relaxation of license restrictions would unleash market activity orders of magnitude beyond these measured steps.

The basic goal of liberalization is to enable markets to allocate radio spectrum. Wireless licenses should be transformed from restrictive authorizations to operate equipment to permissive grants of spectrum access. Licenses should outline the frequency space over which a licensee may operate, but licenses should possess broad discretion to determine intra-band spectrum allocation, operating structures, services, technologies, standards, equipment, and business models. By allowing spectrum to be used as determined by the licensee, spectrum deployment would become subject to competitive market forces. In maximizing profit, licensees would create and provide additional services, economize on spectrum use, deploy new technologies, and lease (or sell) bandwidth to other firms with their own innovative ideas.

The argument is made that relaxation of wireless license rules results in windfall gains for licensees (Calabrese, 2001). This springs from a view that current licensees enjoy a bundle of rights, each with an independent market value; adding extra rights unambiguously increases market value. The view is illusory in both the economic and political dimensions.

The value of additional rights for any one licensee is offset (partially, fully, or more than fully) by a reduction in the value of existing rights due to liberalization. When firms *generally* gain freedom to offer new services or technologies, the reform is a two-edged sword. Each licensee may do more, but potential competitors may do more as well. License restrictions have served as classic cartel enforcement devices, limiting the degree to which rivals compete (Hazlett, 1990). Elimination of such barriers reduces license rents.

A firm that gains a valuable right and has few rents to protect will tend to favor more progressive policies than a firm enjoying significant rents and seeing only limited gains from spectrum flexibility. This explains why the most powerful incumbents have generally opposed spectrum liberalization (even as they occasionally submitted specific waiver requests). Only finely targeted reforms have been in their interest.

From the perspective of consumers, the transfers among licensees are of no consequence. Social benefits flow from the increased use of radio waves to provide service to the public. This occurs with waivers both specific and general. But allowing widespread permissiveness produces more not only than the status quo, but more than a case-by-case waiver request process.

The Commission, or Congress, should supplant the waiver request process by adopting a general policy that non-interfering uses of frequencies allocated to licenses are legal—no matter

the original service, transmission standard, station locations, or technologies mandated in the authorization. This will pre-empt the demand for license waivers. Progress should be judged not by how many new flexible rights are granted, as the Commission now touts, but by how few need be requested.

2.1. Example: low power FM radio

In the recent controversy over low power FM (LPFM) radio, many spectrum allocation system infirmities were exposed. In a recent paper, Bruno Viani and I show that tens of thousands of community radio stations could be slotted into FM frequencies while preserving the same interference standards the FCC has observed for some decades (Hazlett & Viani, 2002). Such new choices for listeners have been effectively stifled by the spectrum allocation process, as only trivial levels of competitive entry (under either the FCCs rule making or Congress' statutory plan, which amended the rule making) were permitted.

A more liberal result is immediately seen via a spectrum property rights approach. The FM dial, under FCC allocation rules, consists of 100 channels, each 200 KHz wide. Not all channels are licensed; within radio markets, the FCC typically leaves three adjacent channels vacant as buffers against interference. Other channels are unused because the FCCs "radio station authorization" reflects the ultra-conservative nature of the "public interest" determination of spectrum usage. Were the regulatory authority, however, to simply cede each licensee control of the airspace allocated on the channels assigned for broadcasting, a new marketplace would materialize.

Instead of arguing for airtight interference rules barring entry, existing radio stations would aggressively compete to create low power broadcasting—and/or other services—that fit within the confines of their existing transmissions. The new "band managers" would have profit incentives to generate new traffic, even if the sum total of such effort lowered aggregate industry profits. That is because the industry-wide agreement not to create new services, embedded in restrictive license rules, would be gone. With every broadcaster free to innovate, competition would break out. Consumers would benefit from improved access to spectrum for businesses, community organizations, educational institutions, and a wide range of speakers now silenced by Commission allocation policies. Moreover, it would move interference adjudication issues into the marketplace, as effective band managers search out compatible uses within their assigned bands. They would not impose zero-tolerance interference rules on spectrum they privately controlled, but would optimize the total value of traffic.

3. Allocate bandwidth on demand

Liberalizing existing licenses will invite wireless entry through voluntary reallocation of radio spectrum. Yet there are two additional policy actions fundamental to a pro-competitive outcome. The first involves restructuring the FCCs interference dispute resolution process, and will be discussed in the next section. The second is to allocate all new spectrum rights requested by users. Today, by categorically walling off bands to limit interference, or to create "spectrum reserves," the Commission (a) restricts output, wasting resources, (b) removes incentives to create spectrally efficient systems, (c) bars experiments with innovative systems.

Take an FM radio market where 12 stations are currently licensed and 100 channels are available under the FCC's band plan. With maximum dispersal of stations, 84 channels are in "use," as each licensee consumes seven slots (an occupied channel and three buffers on either side). If incumbent licensees are given control of all seven channels, each of the existing 12 licensees would be endowed with abundant frequency space with which to generate new services. In addition, 16 channels would be available for entrants. These should be issued to applicants on demand, with mutually exclusive claims assigned by competitive bidding (auctions).

The Commission should relinquish control over channel "inventories" or spectrum "reserves." Rather than withholding bandwidth from productive use to police interference or to provide for future requests, this bandwidth should be available to the marketplace. Where future users demand access to spectrum, it will be supplied by private band owners. New services, such as 3G wireless, need no regulatory approval; suppliers simply purchase spectrum access in the marketplace. These economic inputs will be priced to reflect opportunity costs, revealing the true burdens imposed and forcing tough, efficiency-enhancing choices.

Access to unoccupied bandwidth should be allowed pursuant to a request from a financially responsible party rather than a regulatory determination that harmful interference will not result. Bonding or insurance requirements may be imposed on users such that damage resulting from interference is compensated. While initial contours have legal standing, market transactions will allow for efficient interference standards. Highly valued transmissions will be able to pay to edge out less valuable transmissions. Importantly, private users' liability for damage will yield efficient incentives to respect other transmissions, while *de facto* band ownership drives firms to fully utilize frequencies. The result is a set of incentives parallel to society's goal of maximizing the value of wireless communications.

Requested airwave rights should be quickly assigned to parties that will compete in the marketplace subject to standard contract, property, and anti-monopoly rules. Extraction of revenue should not be a goal of policy makers, as it conflicts frontally with the priority of promoting service to the public. New rights can be assigned by priority-in-use, competitive bidding, or other mechanisms, although the inefficiencies of lotteries and comparative hearings are well documented (Hazlett & Michaels, 1993). In fact, policy makers should aim for a "cheap spectrum" policy that recognizes airwaves as inputs, not outputs, and correctly focuses on low-cost spectrum access as an ingredient into the formation of new communications networks.

To exhaustively license existing bands in an orderly manner, policy makers—or applicants petitioning for spectrum access—can use the concept of "overlay" rights, as used in personal communications services (PCS). New licensees were allowed to use the 1850–1990 MHz band while pre-existing point-to-point microwave users continued operating. The incumbent users had priority, but could move to higher bands. Over time, these frequencies were cleared, with new users paying incumbents to speed migration.

A parallel concept of "underlay" rights can also be used to facilitate the use of low-power devices that operate in the noise floor beneath full-power devices. While such services are most often associated with unlicensed use, coordination problems—including tragedy of the commons—arise with open entry. An alternative that retains unlicensed use and yet allows coordination between well-defined rights owners is to divvy up the noise floor into discrete parcels of bandwidth defined by frequency and power levels. Multiple (i.e., competitive) rights can be issued to parties exercising discretion over spectrum use within a given "underlay," setting

standards and defining emission limits (Hazlett, 2001a). These underlay owners could then sell access rights to device manufacturers, service providers, networks, or other spectrum users. One model is the licensing system used by patent owners. Manufacturers of communications devices would pay a band owner for the right to access frequencies maintained for their use. These charges could levied be per-unit or as a percent of sales, and rights would be reassigned by manufacturers to purchasers of devices.

Creating standard mechanisms to seamlessly award spectrum rights to new wireless applications encourages entrepreneurship. Today, the creators of spectrum-based innovations must travel to market by way of the FCCs spectrum allocation process. This route is arduous and—in the absence of a license award—thankless. Firms must first invest in research and development, discovering new techniques or services. Then they must reveal their findings to the Commission, including proposed business plans, services to be offered, the role of key personnel, and sources of financing. Then they must initiate, monitor, and motivate one or more rule makings, enter numerous filings, arrange for expert declarations, and present a raft of factual data to accompany complex legal arguments. In some instances, applicants must enter into detailed and lengthy negotiations with the representatives of existing spectrum users, reaching frequency-sharing agreements.

These actions are costly and time-consuming, classic regulatory barriers to entry. Under the FCCs traditional licensing rules, however, there was possible compensation: a successful applicant headed the queue for a license, if and when it was issued. The advent of lotteries, first used for cellular licenses in 1984, removed even this return on investment, and auctions, initiated in 1994, extend that result.

In the late 1980s, Henry Geller and Donna Lampert analyzed the effect of the spectrum allocation system on entrepreneurial activity in wireless (Geller & Lampert, 1989). Seeing a slowing of new wireless products, it placed blame on a process that required innovators to bring “a new service or technology through the existing process... [wherein rivals could] ‘cream skim’ the best ideas and begin developing them.” It argued forcefully for implementation of a so-called “pioneer’s preference.” The policy was enacted in 1991, proved an administrative disaster in PCS, and was soon abandoned (Friedman, 1994). But the problem it addressed remains intense. Generally opening spectrum to use by private parties would obviate this disincentive to innovation, as spectrum would be quickly available to new users at its marginal opportunity cost. But prior to overall liberalization, the Commission can institute a revised pioneer’s preference system with bright-line standards, eliminating everyone-a-pioneer pleadings. When a firm clearly moves the Commission to allocate bandwidth for a service that would not exist but for the efforts of the firm, and when that result requires substantial investment in regulatory process, that firm should be rewarded with a license to compete.

3.1. Example: Northpoint technology

Northpoint Technology has developed a patented system to create an extra broadband service in the direct broadcast satellite band (12.2–12.7GHz). Over frequencies now shared by two existing DBS providers, Northpoint would use a hybrid network combining satellite and terrestrial wireless links to deliver about 100 channels of video programming, plus high-speed Internet access service, to residential customers across all US television markets. The firm’s key

technical innovation is to aim transmissions to customer receiving dishes at angles that avoid disrupting reception by existing DBS subscribers. As described by the *New York Times*: “A method for doubling the capacity of even a small part of the broadcast spectrum is potentially a billion-dollar idea. As the information age has come into its own through remarkable advances in technology—which grant the right to use radio frequencies—have become the technological equivalent of Jerusalem: an overcrowded and highly desirable piece of real estate that the existing tenants and outsiders have had a difficult time sharing” (Labaton, 2001).

The FCC has found that the system works sufficiently well that it merits licensing. It has undertaken a new rule making to create licenses for a new service—multichannel video and data distribution systems (MVDDS)—and auction them. In a report filed at the FCC on behalf of Northpoint (Hazlett, 2001b), I outlined how destructive of investment incentives for new technology this would be. Not only will it delay service provision by a minimum of 3 years, obliterating tax revenues (due to services not delivered) while preventing new competition, it taxes innovation in other wireless markets.

The current orthodoxy is that license auctions eliminate both the inefficiencies and the political favoritism of alternative assignment methods. In the standard excess demand situation, the orthodoxy is correct: Not all claimants can be satisfied, and a rationing device must differentiate between economic bidders difficult to distinguish. Yet here, given Northpoint’s singular contributions enabling the technology in question, a competition has already occurred. Imposing a new rationing device in the form of a license auction would appropriate the winner of that bidding process. Just as a second, sequential auction of licenses would eliminate incentives for any party to participate in the first bidding competition, so will next-generation innovators be deterred by Northpoint’s appropriation.

What useful social contribution has Northpoint made? First, Northpoint discovered idle resources. According to official Commission allocation policy, the DBS band was fully deployed. There were no licenses in inventory. There were no further opportunities to assign. Through Northpoint’s ingenuity, a technique for creating a third network occupying the spectrum space that accommodated just two has been created. You can read all about it in the FCC’s rule making, based entirely on the technology invented by Northpoint. The Commission is generous in footnoting this fact (FCC, 2000b).

Second, Northpoint has invested not only in technology, it expended over \$10 million, 1994–2001, in an effort to move the FCC to license its system (Labaton, 2001). This is socially productive; only by invention *and* adoption of Northpoint’s system will consumers have additional choices in multi-channel video subscriptions and broadband access.

To auction licenses, giving other firms equal standing to bid against Northpoint, creates two classes of free riders. Both the government and the potential licensees appropriate returns from investments made by Northpoint. The policy would send a direct message to wireless entrepreneurs: give up now.

This episode illustrates how a pre-occupation with government revenue extraction leads to anti-consumer policies. The argument against Northpoint’s license claim is that allowing the firm to capture full value of spectrum-based services without paying for a license at auction amounts to a subsidy. As AT&T noted in its Comment submitted to the FCC: “Whatever public-interest benefits there may be to granting Northpoint its application—and AT&T submits that there are

none—those benefits would not even approach the value of the spectrum and thus a grant would result in unjust enrichment” (Labaton, 2001).

That the largest US cable television operator strenuously favors competitive bidding reveals the protectionist nature of the policy as applied. The “unjust enrichment” Northpoint seeks is to offer a technology that it has invented; any service the airwaves provide derive their value from the unique efforts of Northpoint. A Northpoint patent does not solve this problem. Whatever is extracted by competitive bidding will tax the returns to creating that patent, a grant that has, in any event, a limited life that may not stretch as long as an FCC rule making. Whatever enrichment flows from the business opportunity thereby created rewards Northpoint for its innovation and encourages investments in other wireless technologies.

I have suggested that the Commission adopt the following multi-part test in seeking whether to assign license directly to applicants or via competitive bidding (Hazlett, 2001b). In a threshold test, it is determined whether excess demand for licenses exists. The question here is whether a request to access airwaves is mutually incompatible with other requests filed at the same time. If requested rights are mutually exclusive, the Commission should seek to remedy the scarcity by making additional rights available in a timely fashion. Where this cannot be done, the license assignment decision moves to a second level analysis where a three-part test is employed:

- (a) Is the new service available specifically due to the efforts of the applicant in question? Has the party invested substantial sums in discovering, proving, and making its system compatible with other spectrum users?
- (b) Would license auctions substantially delay service to customers?
- (c) Would licensing the applicant provide an incentive for other spectrum innovators to bring new wireless applications to the marketplace?

Affirmative answers suggest that consumer welfare is advanced by awarding licenses quickly to innovative spectrum applicants. Only a misapplication of the competitive bidding process would here characterize license issuance as a windfall. Auctions are designed to discover the party willing to risk the most to exploit a given business opportunity; the high bidder is seen as the efficient provider. But when the FCCs spectrum allocation process itself forces competitive rivalry, a firm is established as the efficient provider prior to license auctions. Respecting this result is crucial to economic development because it embodies the process whereby wireless technologies are discovered and implemented.

4. Interference dispute resolution

Limiting regulatory concerns in wireless to interference boundaries is a necessary but insufficient requirement for liberalization. Until the dispute resolution process is fundamentally reconfigured, interference claims may continue to block competitive entry. Indeed, the chief linguistic impediment to spectrum entry is the handy regulatory conversation-killer: “technical reasons.”

The essential problem with interference dispute resolution at the FCC is moral hazard. Incumbents are permitted to oppose applications for new entry virtually without cost, imposing delays that deter competition. Regulatory proceedings to protest interference form an “attractive

nuisance” that existing operators inevitably use to fend off newcomers who threaten to lower prices and steal market share.

Entrants shoulder the burden of proof under the public interest standard. That interference claims are heard in political forums rather than in legal settings, where stricter standards could limit argumentation and judges could impose time constraints, is significant. Under the “public interest,” rules vary from market to market, band to band. If precedents could establish law, greater certainty over standards would obtain and the scope for strategic deterrence would contract.

Interference, like pollution, is a by-product of valuable output. The policy aim should not be to minimize it—a common Commission misconception—but to permit the optimal amount. As with other resources, there are great efficiencies in permitting decentralized market participants to discover, and trade-off, the attendant costs and benefits.

The Commission imposes interference limits that should be negotiated in the private sector. The productive alternative would allow firms to assume the risk that their emissions create harmful interference, using past Commission policies and property, tort, and contract law precedents to assess damages. FCC administrative law judges, or perhaps a newly constituted Spectrum Court, would decide interference disputes as issues of equity. Damages for radio interference would have to be proven, not simply alleged. With compensation mechanisms in place, trades could establish optimal spectrum use. Interference damage of \$1 would not suppress new wireless services worth \$1 million.

New service providers could be indemnified by private insurers. These agents would assume liability due to harmful interference for a fee. Engineering consultants, communications law firms, equipment manufacturers, technology vendors, laboratories (such as those run by MITRE or Lucent, which today engage in testing and field evaluation for many clients, including the FCC), insurance companies, or consortia of these constituent parts would populate this market niche. Harmful interference could occur, but with full compensation. Those with claims to radio spectrum (spectrum owners) emerge as input suppliers, striking bargains with service providers to make resources available for productive enterprise. Instead of central planners imposing a given pattern of usage and divining optimal interference levels across services, markets emerge to make rational trade-offs.

Allowing economic agents to purchase the level of interference protection they demand enhances efficiency. This is analogous to allowing buyers to define the optimal level of energy reliability, a highly productive feature of well functioning markets, “because consumers will vary in the extent to which they are willing to be interrupted, on what conditions, and at what prices” (Smith, Rassenti, & Wilson, 2001, p. 11).

4.1. Example: McCain–Kerrey LPFM interference resolution bill

Senators John McCain (R-AZ) and Robert Kerrey (D-NE) entered legislation (The Low Power Radio Act of 2000, S. 2989, 106th Congress, 2d Session, “To provide for the technical integrity of the FM radio band, and for other purposes”) in the low power FM (LPFM) debate. The proposal, which did not gain congressional approval, offered an interesting approach to interference dispute resolution. To break the impasse where LPFM entrants were subjected to endless challenges by incumbents’ claims of harmful interference, the bill authorized the FCC

to place LPFM licensees in the market with safeguards to pull stations from the air if they were found to degrade existing signals. The measure included “expedited consideration,” such that an interference complaint would come to a final decision in 150 calendar days or sooner. This approach reverses incentives: once entrants are in the market, incumbents have no interest in delaying adjudication of interference allegations. The proposal also contained a penalty provision for full-power stations found to be filing “frivolous” claims against LPFM stations “without any merit or purpose other than to impede the provision of non-interfering low-power FM service.”

The legislation defined “harmful interference” as “interference which... seriously degrades, obstructs, or repeatedly interrupts a radio service...” This statutory language would gain texture as applied by regulators, which is entirely appropriate. Crafting a detailed, theoretical definition of interference delays progress. Real disputes, adjudicated sensibly by reference to historical practice, best inform generalizable results. Decision making soon yields a body of law governing the boundaries of wireless emissions.

The other subtle innovation of this policy approach is to reverse the ordering of events. Instead of all possible interference questions being heard and resolved prior to competitive entry, the entrant is permitted to commence operations. Then, when real emissions are observed and interference claims can be evaluated with actual evidence, questions of trespass are considered. The entrant takes responsibility for conflicts it causes, risking its investment in broadcasting. This substantial economic penalty safeguards existing transmissions from material degradation.

More importantly, the incumbent’s incentive to engage in tactical delay is gone. By simply inverting the process of adjudication and entry, existing users become champions of timely enforcement. Indeed, incumbents might well lobby to tighten the time limits for adjudication, strengthening safeguards for new and existing traffic. Eliminating the open-ended pre-entry debate over interference rules, and the resulting incumbent incentive for delay, constitutes substantial regulatory innovation.

5. Targets of competitive opportunity

Commissions acquire constituencies. These interests are serviced by the various bureaus, offices, or divisions that compose the agency. This process is spontaneous, and cannot be defeated by restricting government hiring to non-industry employees. Indeed, the FCC’s Cable Services Bureau was formed in 1993 with the rule that no cable executives be eligible for employment; within 2 years it began to distinguish itself by issuing rulings highly favorable to the cable television industry (Hazlett & Spitzer, 1997).

The FCC’s old cable TV office, disbanded following deregulation in the late 1970s, offers an instructive, and benign, example of how constituent service works. The FCC first sought regulatory jurisdiction over cable in the early 1960s, when broadcast TV audiences began to be “siphoned” by upstart cable operators. In a 1966 rule making that was a major triumph for the broadcasting industry, the fledgling cable industry was saddled with rules that would thwart its economic development for over a decade. A sleeper in the ruling was that a “CATV Task Force” was formed—a consolation prize for cable interests.

The Task Force became the Cable Television Bureau in 1970, and both were headed by Sol Schildhause, previously an FCC Administrative Law Judge. Schildhause used his position to

conduct proceedings that tended to promote cable television's visibility within the Commission. This made the costs of the FCC's anti-cable policies more apparent and controversial. The infant industry possessed scant political clout, yet over time it succeeded in rolling back key restrictions in programming, local franchising, and federal licensing. Sympathetic officials at the FCC proved an important element in this deregulatory campaign.

Policy makers could today construct a Spectrum Markets Task Force. Charged with investigating the current "spectrum shortage" and intervening in various rule makings on behalf of consumers and competition, the SMTF could seek to implement generic liberalization policies, and to identify particular Targets of Opportunity. (It may be advisable to appoint another FCC Administrative Law Judge as its chief. ALJs are extremely difficult to terminate, limiting political pressure. The professional staff should be maintained such that the following relationship obtains: $E > 2 * [L + ING]$, where E=economist; L=lawyer; ING=engineer.) Outstanding targets include licensing Northpoint Technologies and liberalizing the Low Power FM band. Here is another.

5.1. Example: redeploying UHF TV spectrum to broadband access

AccelerNet is the only company in the United States utilizing UHF television spectrum to provide high-speed Internet service. AccelerNet is the beneficiary of a recent act of the US Congress: in December 2000, Congress passed landmark legislation which allows AccelerNet to provide two-way, high-speed "last mile" services utilizing low power television stations in certain cities across the United States ([AccelerNet, 2001](#)).

Sometimes it takes an act of Congress to gain permission to use the airwaves for something valuable—and sometimes an act of Congress is not enough. Consider the case of Public Law 106–554, signed by President Clinton 21 December 2000. It amends the Communications Act of 1934 to allow thirteen low-power TV stations to go dark, reinventing themselves as providers of two-way broadband Internet access using the same 6 MHz UHF channel assigned their TV stations. (The stations are in Houston, Tampa, Jacksonville, Albany, Honolulu, Phoenix, Bozeman [2], Richmond, Nashville, Kenai Peninsula in Alaska, and Plano and Aurora, Illinois.) The law extends the opportunity offered by a 1998 license granted AccelerNet to supply one-way fixed wireless access over the frequencies (in the 640–650 MHz band) allotted low-power Channel 43, KHLM-LP, in Houston, TX ([Blackwell, 2001](#)).

AccelerNet competes with DSL, ISDN, cable modem, and T1 access among both residential and business users in Houston (see Appendix A). As of April 2001, the firm served over 600 commercial customers ([Blackwell, 2001](#)). With deployment of broadband access a priority for national policy makers, with regulatory approaches to existing cable and telephone company providers provoking intense debate, and with the ensuing regulatory uncertainty spooking financial markets ([Hazlett & Bittlingmayer, 2001](#)), it would appear that a fresh competitor—a fixed wireless entrant—would be a welcome addition.

Yet a simple bureaucratic snafu has stopped the reallocation cold. In promulgating rules to permit the designated stations to begin operations, as required by the statute, the FCC slipped in a deal killer: licenses for the new wireless broadband systems would be temporary, expiring 30 June, 2002. Because investors cannot amortize fixed (and sunk) capital expenses in just 12 months of operation, licensees petitioned the Commission to reconsider its policy. The petitioners

write: “By inserting the sunset provision in the Implementation Order, the Commission has hamstrung the pilot project and doomed it to failure” ([Low Power TV Petition, 2001](#)). Investment is frozen while licensees attempt to secure more favorable terms through Commission pleadings.

A Spectrum Markets Task Force could argue for immediate rule changes to simply extend license rights subject to interference limits (including provisions to terminate licensees creating harmful emissions). It could also promote independent agency action to expand the pilot program to include all low power UHF stations. More ambitiously, it could evaluate a proposal to transfer all television programming to subscription services (i.e., cable and satellite), opening up the entire 402 MHz TV band for generic wireless telecommunications. Conservative estimates of the net social benefits of such a policy reform exceed \$100 billion ([Hazlett, 2001c](#)).

6. Challenges

In summary, the principle structural reforms enabling the emergence of spectrum markets include:

- (a) Permissive airwave use within the interference contours defined by the license,
- (b) Endowment of licensees with use of adjacent buffer zones,
- (c) Exhaustive allocation of remaining bandwidth to new applicants,
- (d) Streamlining the process whereby entrants gain access to unoccupied bandwidth, using liability rules and post-entry dispute resolution mechanisms to police interference.

Any ambitious spectrum reform proposal appears impractical, if not downright fantastic. In a 1978 article, former Federal Communications Commission member Glenn O. Robinson outlined the argument in favor of abandoning comparative hearings in the assignment of wireless licenses. His argument was compelling, but dismissed as hopelessly unrealistic. In an FCC ruling the previous year, in fact, two Commissioners announced the odds on adoption of either license lotteries or auctions “about the same as those on the Easter Bunny in the Preakness”—a famous American horse race ([Robinson, 1978](#)). In his article, Robinson claimed to agree.

The experts should have bet on the bunny. By 1981, lotteries were approved by Congress; in 1993 auctions were law. These time lags were substantial, but note that the FCCs regulatory campaign for “advanced television” is yet hanging by a thread, some 15 years after its formal initiation ([Brinkley, 1997](#)). Regulation as usual is not a reasonable alternative to serious reform, no matter the challenges. Spectrum liberalization is our one plausible strategy for progress.

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Appendix A

AccelerNet Broadband Services: Competitive Comparison. Source: <http://www.accelernet.net/services/index.html>.

ACCELERNET DSL™ Wireless Service	Typical Wired ISDN Service
<p>Transport Media: Broadband Wireless downstream with an analog modem (POTS) return path</p> <p>Bandwidth: 512Kbps (four times the speed of a traditional hard wired 2-channel dedicated ISDN line) downstream with 14.4Kbps to 33.6Kbps upstream</p> <p>Monthly ISP cost: \$160</p> <p style="text-align: center;">PLUS</p> <p>Dedicated analog telephone line (Plain Old Telephone Service--POTS) \$30-40</p> <p>Total Monthly Charges: \$190-200</p>	<p>Transport Media: Traditional hard wired ISDN line</p> <p>Bandwidth: Two channel dedicated ISDN line with 128Kbps total bandwidth</p> <p>Monthly ISP Charge: \$200 to \$400</p> <p style="text-align: center;">PLUS</p> <p>Local loop charge for ISDN line access: \$40.00 to \$75.00</p> <p>Total Monthly Charges: \$240 to \$475.00</p>
ACCELERNET DSL™ Wireless Service	Typical Wired T-1 Service
<p>Transport Media: Broadband Wireless Access downstream with an ISDN return path</p> <p>Bandwidth: 2Mbps downstream with 128Kbps upstream</p> <p>Monthly ISP cost: \$200</p> <p style="text-align: center;">PLUS</p> <p>Local loop charge for ISDN line access: \$40.00 to \$75.00</p> <p>Total Monthly Charges: \$240 to \$275</p> <p>Total Equipment & Installation Charges: \$700</p>	<p>Transport Media: Traditional hard wired T-1 line</p> <p>Bandwidth: Clear channel full duplex T-1 line with 1.544Mbps total bandwidth</p> <p>Monthly ISP Charge: \$500.00 to \$1000.00</p> <p style="text-align: center;">PLUS</p> <p>Local loop charge for T-1 line access: \$200.00 to \$1000.00</p> <p>Total Monthly Charges: \$700.00 to \$2000.00</p> <p>Total Equipment & Installation Charges: \$2500.00 to \$8500.00</p>

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