Coase and the New Zealand Spectrum Reforms

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Introduction

In 1989, New Zealand's Parliament enacted a new statute, the Radiocommunications Act 1989, that explicitly used a system of property rights to regulate the use of the radio spectrum.[1] This statute resulted in the first ever spectrum auctions—and New Zealand's use of auctions has been copied around the globe. New Zealand's adoption of a property-rights regime, a more fundamental change than the introduction of spectrum auctions, has not had the same wide acceptance.[2] How did New Zealand's adoption of a property-rights approach to spectrum come to pass? What role did Coase's 1959 article play in the decision to adopt a property-rights approach and in the design of the property-rights mechanisms? How does the New Zealand system (both in theory and in practice) differ from a naïve application of Coase's insights?

It is my goal in this paper to address these questions. I was on the team that developed most of the system that is embodied in the New Zealand statute, and I participated in some of the drafting sessions for the statute.[3] In recounting the background of the New Zealand project, I also have to describe Coase's influence on my own thinking. Although I conclude that the spectrum rights regime in New Zealand reflects Coase's insights and, most probably, would not exist without his work, I indulge in some speculation about the benefits of broader and earlier implementation of a property-rights approach to spectrum management.

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[1] A history of radio use and regulation in New Zealand is available at http://www.rsm.govt.nz/cms/resource-library/publications/a-brief-history-of-regulation-of-radiocommunications-in-new-zealand.

[2] It is likely that New Zealand is the nation least constrained in the use of spectrum by the need to coordinate its spectrum use with other nations. New Zealand is separated from its nearest major neighbor by about 1,000 miles and is even farther from other major spectrum users. This separation simplified both the practical problems of defining and implementing a rights system and the political issues associated with adopting one. New Zealand is constrained by technology. New Zealand's population of about 4 million is not large enough to justify the development of radio equipment for the New Zealand market alone. Consequently, New Zealand must, for the most part, use equipment designed for world markets.

[3] The team was led by Robin Foster. Other key participants included Robyn Druie (a lawyer from London who had gone to law school in Australia), Phillipa Marks, and William Shew. Jerry Hausman reviewed drafts and provided helpful guidance. Ian Hutchings was the Department of Trade and Industry staffer who directly supervised the project; he contributed substantially to the quality of the work and the success of the project.

Economic Reform in New Zealand

New Zealand's 1984 elections put the Labour party in control of Parliament after Labour had been out of power for a decade. At the time, New Zealand's economy was suffering, and Labour chose to use privatization and deregulation as tools to improve economic performance. An early step in this process was to separate the Post Office into three entities—a state-owned telephone company, a state-owned postal company, and a spectrum regulator. Before that, the Post Office, a major spectrum user, had also been the spectrum regulator. The government did not stop with this separation of functions. In 1987, the government stated that it intended to end the telephone monopoly, and in 1988, the government commissioned a study by John Fountain, an economist at the University of Canterbury, to review the literature on the economics of spectrum management.[4] The first two articles addressed in Dr. Fountain's review were Coase's 1959 article and Coase's 1962 article.[5] The report was not directly an analytic or advocacy piece; nevertheless, it did clearly communicate the view that economic mechanisms for spectrum management were feasible and promised significant benefits.

The NERA Report

As the Fountain Report was being finished, New Zealand issued an invitation to tender for a study on the management of the radio frequency spectrum. The terms of reference for the study identified three objectives:

- Maximize economic efficiency in use of spectrum
- Examine financial returns to the government
- Recommend practical and equitable options for spectrum allocation and management

In July 1988, New Zealand's Ministry of Commerce contracted with NERA's London office to conduct the study, which was completed by about November 1988. The members of the study team each spent about two months in New Zealand, meeting with

[4] *The Economics of Spectrum Literature: A Survey of the Literature,* John Fountain, 1988, Department of Trade and Industry, Wellington, NZ.

[5] "The Federal Communications Commission", Coase, R. H., *Journal of Law and Economics* Vol. 2, pp. 1-40, 1959. "Inte Interdepartmental Radio Advisory Committee," Coase, R. H., *Journal of Law and Economics*, October Vol 5, 1962.

the affected industry, many staff from the Department of Trade and Industry, and individuals from elsewhere in the government.

Our report had many recommendations, a few which may be worth noting:[6]

- The primary tool for spectrum management should be a property-rights system.
- Spectrum that was intrinsically international, such as spectrum below 44 MHz and spectrum internationally allocated for air-traffic control, should be excluded from the property rights regime.
- There should be an option for unlicensed use of the spectrum.

The property rights system that we recommended was modeled after the Torrens land title system that is widely used in Commonwealth Nations. Property rights were to be recorded in a central registry, and the entries in that registry would define the property and identify the ownership. Property could be subdivided and sold off; property could be combined. The parallels to the real estate rights system were extensive.

The basic property right that we recommended as a starting point was a nationwide band of frequencies with limits on out-of-band emissions. We referred to these as *band licenses,* and the legislation called them *management rights*. We also recommended more restricted rights packages—which we called *spectrum products*—that were more or less equivalent to the traditional site licenses used in the United States for TV stations or private mobile radio. Under our proposal, the owner of a management right could sell off parts of that property as spectrum products. The corresponding concept was called a *spectrum license* in the legislation.

We emphasized that the more spectrum, in bandwidth and in geography, covered by a rights-package, the less concern there need be about the rules at boundaries and the greater scope there was for private negotiations to define boundaries.

We also recommended that New Zealand retain the capability of granting traditional licenses. This capability could be used in the spectrum below 44 MHz and in other

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[6] *Management of the Radio Frequency Spectrum in New Zealand*, Robin Foster et al., NERA, London, November 1988, ISBN 0-477-05973-2. (NERA Report). Available at http://www.jacksons.net/NZ%20Spectrum%20Report%201988.pdf.

special situations where it was simpler to continue to use licenses than to try to transition to a property-rights regime.

The audience for this paper understands the arguments for our recommendation of a property-rights system.

Our recommendation to exclude the spectrum below 44 MHz from the property-rights system was based on several facts, including (1) in this region of the spectrum, radio waves travel around the globe—transmissions in New Zealand on these frequencies can create interference in Australia or Chile or California; (2) there were a variety of incumbents; and (3) this is a minute slice of the entire spectrum (4% of the spectrum below 1 GHz and 0.4% of the spectrum below 10 GHz).[7]

Our recommendation for an unlicensed alternative flowed from the recognition that unlicensed radio systems had proven to deliver substantial value and new technology offered the promise of increases in that value.

One of the most difficult issues to deal with was the problem of incumbents. We were not dealing with a clean slate. Rather, there was already extensive use of the radio spectrum in New Zealand, and it was necessary to consider how a transition to a new type of rights could be done without excessive cost or dislocation. Giving the government the ability to use traditional licensing was one useful tool for dealing with incumbency as well as with various international constraints.

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[7] I believe that much of the structure of traditional spectrum regulation arises from three historical events. First, the primary uses of radio in its first two decades were for safety-of-life-at-sea and military communications—areas where regulation and government control had long been accepted. Second, radio waves at the low frequencies that could be exploited before about 1930 travel far beyond the horizon. Communications at such long distances is useful, but if one can communicate, one can also interfere. Thus, an AM radio station on 600 kHz in Kansas City can interfere with the reception of every AM radio station on 600 kHz elsewhere in the continental United States. If cattle being raised in Kansas could magically graze in every corn and grain field in the nation, it might be easier to directly regulate cattle growers than to have farmers and ranchers negotiate a price for harm caused by cattle. Property rights are hard to define in a world in which every transmitter's signal interferes with the reception of every other transmitter's signal. Third, the second major application of radio technology, after maritime communications, was audio broadcasting. Broadcasting brings difficult issues, including those associated with media generally, public goods problems, and issues arising from the divided ownership of the transmitting and receiving systems.

This combination of factors probably made the highly centralized spectrum management system developed between 1900 and 1934 the most efficient alternative at the time.

The Legislation

The legislation adopted most of our recommendations. The legislative drafting process forced greater attention to detail and a careful formulation of the rights regime than was present in our report. The legislation was enacted in late 1989—just about one year after we delivered our report and less than two years after Dr. Fountain began his literature survey.[8]

There were several practical aspects of the system defined by the legislation that were lacking from our report:

The holder of a management right (owner of spectrum property) was permitted to grant licenses to others to operate within the spectrum defined by the management right. The legislation imposed a requirement that a radio engineer certify that operation under such a

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[8] No doubt, American readers are wondering how such swift action is possible. Part of the answer lies in the structure of New Zealand's legislature—it is a unicameral parliamentary system. Cabinet makes policy decisions, and legislation is drafted to reflect those decisions. There is much less need to draft legislation in order to attract votes than there is in the United States; typically, the votes are there before the drafting begins. A side effect of this process is that legislation can be written clearly because there is no need to have clauses whose meaning is fuzzy or contradictory and that can attract votes by virtue of their multiple interpretations.

The legislative process in the United States sometimes contrasts sharply what that of New Zealand. In an article published in the New York Times on October 1, 2001, Stephen Labaton wrote of the 1996 amendments to the Communication Act that it was "what most experts consider to be one of the sloppiest laws on the books." He went on to write:

> "It would be gross understatement to say that the 1996 act is not a model of clarity," Justice Antonin Scalia wrote for the majority of the court in an earlier version of the telephone network rate cases that will be heard again in 10 days. "It is in many important respects a model of ambiguity or indeed even self-contradiction. That is most unfortunate for a piece of legislation that profoundly affects a crucial segment of the economy worth tens of billions of dollars."
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> Seth P. Waxman, a former solicitor general in the Clinton administration, who argued cases involving the act, was more succinct.
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> "It is the single most poorly drafted statute ever enacted by Congress," he said in an interview. He recalled a telling incident during the oral argument in the earlier case decided by Justice Scalia, in which the justice expressed jocular skepticism after William P. Barr, the general counsel of Verizon and former United States attorney general, began his oral presentation by referring to the "plain language of the statute."
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> "There is no plain language in that statute," Mr. Waxman said. "It is the product of extended negotiations among telecom lobbyists, each trying to get a little something to bring back to their clients."

license would not cause problems and that the license clearly described the rights granted. The specific requirement is as follows:

> In the opinion of that engineer, the exercise of rights to which the spectrum licence relates—
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> (a) will not endanger the functioning of any radio navigation service; and
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> (b) will not endanger the functioning of any radio service essential to the protection of life and property; and
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> (c) will not cause harmful interference to rights conferred by registered spectrum or radio licences; and
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> (d) is technically compatible with services authorized to be operated under existing spectrum licences and radio licences; and
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> (e) will sufficiently define the protection area and the nature and characteristics of the proposed transmissions to enable subsequent spectrum licences and radio licences to be coordinated with the exercise of rights to which the spectrum licence relates for the purpose of avoiding harmful interference.[9]

An entire part of the statute is devoted to mortgages—how to register mortgages, the order of payment when a property is sold to satisfy claims under a mortgage, and so on.

There is a prohibition on the owner of a management right selling a portion of the management right if a consequence of that would be to make one of the licensees a tenant of two landlords.[10]

If a mistake in the government's operation of the register of frequencies leads to harm to a person, that person can bring an action against the government to recover damages.

We had not addressed any of these issues.

We suggested that the rights should be issued in perpetuity—but offered an alternate of 20 years to be chosen "if preferred by the government." The statute set the term of the management rights at 20 years.

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[9] Radiocommunications Act 1989 25(5).

[10] This prohibition can be waived with the consent of the licensee.

The New Zealand System in Practice

As best I can tell, the property-rights spectrum regime in New Zealand functions much like spectrum regulation in other nations.

A substantial fraction of the spectrum is still managed by a traditional licensing system. In those regions of the spectrum where the government has not yet created management rights, traditional licensing is used. This applies to much of the spectrum below 500 MHz. In addition, some management rights are owned by the Crown, and the Ministry of Economic Development grants licenses—either through auctions or on a first-come, first-served basis, depending on the specific radio service. For example, the FM radio broadcasting band (88.8–106.3 MHz) is a management right owned by the Crown Acting by and through the Chief Executive of the Ministry of Economic Development. The cellular and PCS bands are divided into several management rights—the major cellular carriers own the bulk of them.

An examination of the management rights registry on November 9, 2009, showed that there were 91 current management rights registered. These rights covered about 5 GHz of spectrum and accounted for about 17% of the spectrum below 30 GHz. However, in the region below 3.6 GHz, about 1.4 GHz is under a management right and about 1 GHz of that is not held by the Crown. The management rights not held by the Crown are concentrated above 800 MHz and account for roughly one-third of the spectrum between 800 MHz and 3.6 GHz. This is a significant fraction of the spectrum best suited to personal wireless and wireless broadband access using current technology.

In practice, the activities under New Zealand's management rights are much like those under the flexible cellular and PCS licenses auctioned off by the FCC. Some of the management rights have the same frequency boundaries as do FCC licenses. As mentioned above, New Zealand is constrained to use radio communications systems designed for world markets; consequently, it makes sense to match property boundaries to the boundaries associated with equipment available in world markets. Moreover, I remember several meetings in which I used the example of the cellular band licenses in the United States as examples the feasibility of such rights packages.

Two major differences between the New Zealand property rights and the rights of FCC licensees for cellular and PCS are worth comment. First, FCC licenses are for a fixed term but renewal is almost certain. Consequently, some incentives for long-term planning and investment may be stronger for FCC licensees than for holders of time-limited management rights in New Zealand. Second, New Zealand's management rights include specified protection against interfering signals transmitted by others. That protection includes specific limits on transmissions by others within the area of the management right.[11] This right is quite unlike comparable rights under FCC regulation. Typically, the FCC regulates the out-of-band emissions of licensees (e.g., cellular licensees are constrained not to transmit outside their assigned bands at powers exceeding −43 dBW).[12] But, the FCC offers no guarantee to a licensee that the rules limiting the signal power from adjacent channels will not be changed or that the FCC will not create a new radio service that will transmit within the band and geography currently used by the licensee.

Even if radio transmitters are operated in accord with well-defined management rights, there will still be instances of interference. For example, a high-power transmitter located close to a sensitive receiver may overwhelm that receiver. In the New Zealand system, *lawful interference* occurs when transmissions that are authorized by the terms of a management right create interference with a radio system operating within a different management right. New Zealand's Radiocommunications Act uses arbitration to deal with problems of "lawful interference." The criteria the arbiter is to use to resolve such disputes are set forth in the statute.[13] When similar events occur in the United States, the FCC acts as arbiter but without similar statutory guidance.

It will be interesting to see whether, over the next few decades, the management rights in New Zealand in the spectrum region between 800 MHz and 3.6 GHz lead to greater

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[11] The default value of such transmissions is−50 dBW (10^{-5} watts). This level is high enough to permit systems such as ultra-wideband to operate. It is lower than the default constraint (−43 dBW) found in many FCC licenses.

[12] 47 CFR 22.917(a). However, adjacent band licensees are allowed to negotiate different limits.

[13] The NERA Report (p. 170) recommended that the resolution of lawful interference be done through the courts but suggested use of arbitration as an alternative.

service innovation or more efficient spectrum use in these bands than elsewhere in the world.

Regrets

Looking back, my biggest regret with the outcome in New Zealand is the term of the property right. We recommended a perpetual term, like land tenure, but in a wishy-washy fashion—and not in a fashion well designed to convince the audience of the superiority of a perpetual term. In retrospect, we should have argued more strongly for a perpetual term and emphasized that a compulsory purchase process (eminent domain) could always be used to provide the government with the flexibility needed to restructure bands or modify spectrum use.

My second regret is that our recommendations for the UHF spectrum were not adopted. We recommended that the UHF spectrum (494–806 MHz) be auctioned as six bands, five 56-MHz bands and one 32-MHz band.[14] The choice of 52 MHz as the basic band size was based on the fact that we were informed that next-generation TV in New Zealand might use either 7- or 8-MHz channels—a 56-MHz band could be divided evenly into either 7-MHz or 8-MHz channels. These management rights would have been capable of supporting either wireless access services or broadcast services. They could have initially supported broadcast services and then have been transitioned to wireless access if wireless access became a more attractive use. Here in the United States, we have gone through a difficult process in order to transfer part of the UHF TV spectrum to nonbroadcast uses. The sale of management rights would have put in place a market mechanism for the transition in New Zealand.

However, the New Zealand government chose to auction off the band as licenses for TV stations. I was told that no one expressed interest in the band licenses, but people did express interest in licenses for TV stations. Hence, the government chose to auction the TV station licenses. Perhaps a better exposition of the benefits of the management rights approach would have changed the outcome.

[14] NERA Report, p. 201.

Some have criticized the New Zealand spectrum rights process for the use of a sealed-bid, second-price auction in their first auction.[15] Our report recommended that form of an auction. We spent little time considering the auction process. Our focus was on understanding the existing environment, designing a rights system that would work and would be politically acceptable, and explaining our analysis. Although, in retrospect, we either should have put more resources into the analysis of auctions or should have simply recommended that New Zealand hire an investment bank to run the auction and give the bank a 5% cut of the revenues, it seems to me that that losses from New Zealand's auction of inefficient rights for the UHF spectrum dwarf any losses from the use of an ugly auction format.

Coase's Influence

I find it difficult to identify exactly the direct influence Coase's 1959 article had on the New Zealand spectrum project. That is not because I think that the article did not affect the project. Fountain cited it. All the members of the project team had read it—most of us had read it many years earlier. The propositions of the Coase article were to us like water to fish—they were an accepted part of the world.

I have a more concrete recollection of how Coase's 1959 article affected my own thinking some years earlier. I was a graduate student at MIT in electrical engineering. My background before graduate school was in computer science and communications engineering. I had become interested in operations research, and MIT has an interdepartmental operations research program that permitted me to pursue studies in operations research as a graduate student in electrical engineering.[16] My master's thesis advisor was Professor Richard Larson—an excellent teacher and researcher. He was doing research at the time on operations management in public safety systems. Professor

[15] See, for example, "Selling Spectrum Rights," John McMillan, *Journal of Economic Perspectives,* Vol. 8, No. 3, Summer 1994, pp. 145–162. McMillan notes that a political problem for second-price auctions is that they reveal how much surplus the winning bidder thinks he gains. He also notes that this problem may be more severe in auctions with few bidders.

[16] The upside of participating in the operations research program was that, under some circumstances I could remain a graduate student even if I washed out of electrical engineering. The downside was that I had to take two sets of qualifying examinations. I recall at least two oral and two written qualifying exams—and there may have been a third oral examination of which I cannot remember the details.

Larson suggested that an interesting research problem that would match my background would be issues in spectrum management for public safety. The particular question, as best I recall it, was the following:

> The public safety community has access to a limited pool of radio channels. There are interference constraints—if a channel is used in Boston, it cannot be used in any of the nearby communities. If a channel is used in Concord, it may be reused in Cape Cod but not in Boston. As agencies and budgets grow, agencies request additional radio channels. Given the interference constraint and the disparate nature of the communities, what algorithms could be used by the frequency assignment entity to maximize the benefits from the use of the limited supply of radio channels?[17]

I worked on this problem for a while from a very traditional operations research viewpoint. I looked at questions of the form "Assuming that requests for new channels are represented by Poisson arrivals in a two-dimensional space, what policy for assigning a channel to a request for a new frequency maximizes the number of requests that can be granted?"

I ended up completing my master's thesis, but I was not satisfied. My approach failed to deal with the problem created in trying to trade off the use of a radio channel by the Boston Fire Department against the use of that frequency by the Fire Department in Concord—a city with about 2% of the population of Boston. That is, my analysis offered insight and understanding of a problem that was not a very good match to the problem in the real world.

At some point, I was introduced to Coase's 1959 article and the literature it inspired. Bingo! The insights in that article showed how to resolve the problem that had left me frustrated. It inspired me to address a related problem in my PhD thesis—how can one define spectrum rights that permit markets to function?[18]

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[17] As I recall, although the nominal frequency management entity was the FCC, they relied on the recommendations of frequency coordinators. The public safety coordinator in Massachusetts was an experienced radio communications officer who basically knew everybody in public safety communications in the state and what was being done on each channel. He used paper records.

[18] *Technology for Spectrum Markets,* Charles Jackson, MIT PhD thesis, November 1976. To my knowledge, the rights systems developed in that thesis have never been implemented. Chapter 5 did describe combinatorial auctions and established some basic facts about them such as the fact that using generalized Vickery prices yield a Nash equilibrium but that bidders can collude to their advantage under a Vickery pricing regime (i.e., the Nash equilibrium is not in the core of the game). This combinatorial auction was applied to the problem of auctioning off site licenses, such as are used by TV stations, subject

At the time that I was working on my PhD thesis, I was also working part time at the FCC where I was engineering assistant to FCC Commissioner Robinson. For some reason, I wrote a fan letter to Professor Coase—probably in 1974 or 1975—on my FCC stationary. I believe that the essence of my letter was, "Your stuff is great and useful. I look forward with pleasure to reading anything you write." I received back from him a nice one- or two-page handwritten letter—which alas I cannot find in my files. All I can recall about his letter at this distance in time is (1) I was pleased to receive it and (2) the handwriting was a little hard to read.

After I completed my PhD, I worked briefly at the FCC and then went to work for the House Commerce Committee's Subcommittee on Communications. The subcommittee's leadership, both the Chairman and the Ranking Minority Member, had announced an ambitious project to rewrite the Communications Act of 1934.

The purpose of this rewrite project was not necessarily to reform the Communications Act but to buy time. By 1976, the FCC had authorized a little long-distance competition in the telephone industry. The established telephone industry went all out to get legislation to end such competition. The industry's lobbying strategy was to sign up a lot of cosponsors and to try to push their bill through Congress using their legislative contacts in every district.

The Communications Subcommittee leadership and staff felt that the proposed legislation was unwise. At one hearing, Fred Kahn, then Chairman of the New York Public Service Commission, had called the bill "an abomination."[19] However, opposing an industry that accounted for about 2% of the economy; that was dominated by a single firm, AT&T; and that had many employees in every congressional district was a daunting and

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to interference constraints. This auction combined the assignment of channels to locations with the assignment of channels to licensees. I probably should have published that chapter more widely than in a PhD thesis available from University Microfilms. One survey article on combinatorial auctions does give me credit for being the first to develop combinatorial auctions. See "Combinatorial Auctions: A Survey ," Sven de Vries, Rakesh V. Vohra, *INFORMS Journal on Computing,* Vol. 15, No. 3, Summer 2003, pp. 284–309, DOI: 10.1287/ijoc.15.3.284.16077. However, the field grew up completely independently of my work. And if I had published more widely, Professor Coase would also get credit for stimulating the development of combinatorial auctions.

[19] See the description of the bill at http://www.heritage.org/research/socialsecurity/upload/91248_1.pdf

intimidating task. The strategy that the subcommittee leadership adopted was to announce that they were going to start a process to rewrite the entire Communications Act. The rewrite project effectively ended the industry bill by bogging down the consideration of telephone industry reform with the consideration of a host of more politically sensitive issues such as reforming the public trustee concept of broadcast licensing, abolishing the FCC, and restructuring public broadcasting.

One of the first concrete actions that the staff undertook in the rewrite process was to prepare a set of options papers suggesting alternative approaches to the regulation of everything that the FCC touched. I was assigned to write the options paper on spectrum. That options paper mentioned Coase's work in the body and listed four of his articles in the references. That options paper fell short of offering a property-rights option; however, it did suggest auctioning licenses.

The staff option papers were widely circulated in the industry and drew lots of comment—mostly negative. AT&T's reaction to the suggestion of auctions was unenthusiastic. They referenced the work of a 1970 National Academy of Engineering report that, according to AT&T, "considered the plan [economic spectrum rights] unworkable." AT&T summarized their position thusly:

> The Bell System recognizes that the present process used in the U.S., although imperfect, has not led to chaos, but, in fact, has resulted in the most advanced and extensive use of the radio spectrum. Consequently, changes on purely hypothetical ground or solely for the sake of change should be avoided. It may be better to merely strengthen the present process where needed that to attempt wholesale changes.[20]

A group representing interests in the land mobile industry wrote,

> The auction and lottery mechanisms . . . are considered unworkable.… To auction frequencies generally and to "convey title" to them boggles the imagination.[21]

In 1978, the bipartisan committee leadership introduced a bill, HR 13015, that proposed a complete rewrite of the Communications Act. Besides including many dozens of features that were strongly unpopular with one interest group or another, it included language that

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[20] Comments of American Telephone and Telegraph Company on "Policy Options for the Spectrum Resource," July 1, 1977.

Times change. Thirty years later, AT&T told the FCC

> AT&T also believes there was strong record support for continuing to license spectrum for mobile services through auctions of exclusive, flexible use authorizations. Historically, these market-based policies have allowed spectrum to rise to its highest and best use and driven the wireless ecosystem to continually innovate in services, products and pricing.
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> AT&T Reply Comments FCC GN Docket No. 09-137, November 13, 2009 at p. ii.

And, AT&T is not alone. A recent filing by QUALCOMM at the FCC has a subheading that reads *To Spur Innovation, Spectrum Should Be Auctioned with Flexible Use Rights and Liberal Property Rights.* QUALCOMM Comments in FCC GN Docket 09-157, September 30, 2009 at p. vi. Those comments used the term *property rights* 14 times. Available at http://fjallfoss.fcc.gov/ecfs2/document/view?id=7020039976.

Similarly, a recent filing by Verizon Wireless endorses auctions and property rights. It states "Economists have consistently endorsed Commission efforts to provide licensees with strong and flexible rights in the form of geographic licenses that can be purchased at auction and traded on the secondary market, as it is through such policies that the Commission can ensure that spectrum is put to its highest and best use." Verizon Wireless Comments FCC GN Docket N0. 09-51, October 23, 2009. (footnote citing Coase's 1959 paper omitted the quotation)

[21] Letter from L. M. Himmel, Association of American Railroads, 27 June 1977.

would permit the FCC to use "economic choice methods" in choosing licensees in nonbroadcast services. This was a timid step—we did not even use the word *auction.* This approach did nothing directly to strengthen a property-rights approach to spectrum management.[22]

One apparent effect of the rewrite process was to kindle interest in the Carter Administration in the reform of spectrum policy. In 1979, President Carter endorsed the concept of auctions of radio licenses. Even as administrations changed, the executive branch's view, expressed at NTIA in the Department of Commerce, remained steady—auctions were a good policy. But, it was not until the same party controlled the Administration and Congress that it was possible to move legislation that permitted auctions.[23]

Thus, by the time I came to the New Zealand spectrum project, I had read the 1959 Coase article several times and had had the experience of defending its reasoning in a variety of political contexts.

Summing up, it is incontrovertibly true that Coase's work was a major influence on the thinking of the team that designed the New Zealand spectrum rights system. Moreover, it is probably the case that, without his work and the work of others that was inspired by it, the new Labour government would not have chosen in 1987 and 1988 to pursue developing a property-rights system. It is also the case that Coase's paper influenced the policy debate in the United States and contributed to the executive's branch decision to support license auctions.

A Thought Experiment

Although Coase's 1959 paper was clearly enormously influential, it is sobering and instructional to consider what the outcome would have been if his insights had been

[22] The legislation did propose that radio (aural) broadcasting licenses be made permanent. But, that proposal was based on political considerations—not reasoned policy analysis.

[23] Balanced Budget Act of 1993. The move to auctions was also spurred by the FCC's decision to use lotteries to choose among applicants for cellular licenses. Lottery mills proliferated and thousands of applications flowed in for each license. Some lottery winners quickly resold their licenses for tens of millions of dollars.

adopted earlier and more completely.[24] Consider a different world in which Labour came into control of the U.S. government in 1960. At that time, the UHF TV spectrum—470 to 896 MHz—was essentially vacant and the technology to exploit that spectrum was primitive compared with what became possible over the next several decades. Suppose that new Labour government, inspired by Coase's 1959 paper, had directed the FCC to auction off management rights (nationwide band licenses) to 420 MHz of UHF spectrum in seven lots of 60 MHz each. Assume also that there were competition policy constraints that prevented any party from buying more than one unit. One possible outcome of the auction would have been for the seven purchasers to have been AT&T, Motorola, RCA (NBC), CBS, GE, Western Union, and GTE.

In this what-if world, AT&T would have first used its license for low-capacity microwave systems such as links from remote central offices to the main network. Later, as it developed better mobile telephone technology, it would have used part of this spectrum to deploy systems such as IMTS and, some years after that, cellular. No FCC rulemaking would have been needed to bring cellular to the market.[25] The wireless market would have exploded earlier, and U.S. consumers and manufacturers would have benefitted.

Motorola would have pursued its traditional market of private radio systems, including public safety. Marketing and product design would have been simplified because Motorola would have been able to offer its dealers and customers true one-stop shopping and engineers could be confident that even unconventional designs would be able to gain access to spectrum. Given access to this large block of spectrum, Motorola would have turned its design efforts to building a portfolio of radio systems for voice and data meeting different cost points and different spectrum-efficiency measures. Low-cost, spectrally inefficient radios would have been designed for use outside urban areas; more

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[24] I thank Peter Pitsch for suggesting the analysis of a similar thought experiment.

[25] IMTS stands for Improved Mobile Telephone Service, a trunked mobile telephone service that was a precursor to cellular. It was introduced in the early 1960s. A typical system provided up to 12 voice channels that were shared by all users—that is, if a city had 500 mobile telephone users, only 12 of them could be in a call at the same time. If AT&T had built a system using the same voice technology as IMTS but with access to 30 MHz of spectrum (half of the assumed AT&T license), it would have been able to serve 600 simultaneous conversations in a community. With reasonable channel loading, this might have permitted serving about 20,000 subscribers.

costly but more spectrum-efficient systems would have been developed for urban areas. Motorola would have offered a variety of interconnected voice services—gradually evolving into a voice and access supplier competing with AT&T.

CBS and RCA would have first used their spectrum to provide microwave links between studios and transmitters, for electronic news gathering, and for translators to improve the coverage of their VHF stations. However, they would have soon built TV broadcasting networks in their bands—building 8- or 10-channel wireless cable systems in urban areas. Such licensees would have had incentives to do more counterprogramming rather than dividing the audience for "modal" programming.

Also, as large nationwide licensees, these broadcasters would have been able to squeeze in many more cochannel and adjacent channel transmitters on their licenses. But, as things actually happened, the FCC's attempt to create "short spaced" stations or other wise increase the supply of TV stations was frequently slowed or stopped by incumbent opposition. Such opposition was natural enough; the incumbents would have incurred costs and others would have received the benefits. In contrast, with these nationwide band licenses, the band owners would still have incurred some costs but they would also have received the commercial benefits.[26]

These broadcasting-oriented band owners would also have had incentives to negotiate with set manufactures to produce better receivers—receivers with better ability to distinguish signals on nearby channels and receivers supporting new services. RCA was itself a TV set manufacturer. It is likely that RCA would have engaged in a continuous process of adding new features and options to its transmission services and offering TV sets that could receive these features. For example, RCA could have brought out a TV set that could tune adjacent UHF TV channels if they were all transmitted at the same power from the same location.[27] Services such as stereo audio, improved picture definition, integrated text services all would have been explored. In such a world, is easy to imagine that some of these seven national licensees would have achieved national

[26] It is likely that the bulk of the benefits would have gone to viewers.

[27] The FCC rules for the UHF spectrum only allowed one out of every six channels to be used in a city. Thus, analog UHF channels 20, 26, and 32 were licensed in Washington, DC.

broadcast footprints making it feasible to create a four or fifth television network decades earlier.

Western Union would have begun by using its spectrum to provide private-line services to corporate customers and the government and some long-haul networks. It would have ended up leasing half its band to RCA—permitting RCA to offer a 15-channel TV service in most communities.

GE would have used its spectrum for mobile services, somewhat like Motorola, and for private-line services. GE would also have acted much like what we call a band manager today—selling licenses to a variety of users and high-tech innovators. Ultimately, GE would have developed a portfolio of mobile voice services fitting in between those offered by Motorola and AT&T.

GTE would have offered mobile services much like AT&T's in communities served by GTE telephone companies. It would have leased most of its spectrum in other communities to CBS, permitting CBS to offer a 20-channel TV service in most of the nation.

In this what-if world based on following Coase's insights, modern wireless would have developed along slightly different lines with less emphasis on cellular reuse but earlier emphasis on reducing the cost of the user equipment and expansion of the scale of the market. Service much like early cellular service would have appeared in the market perhaps 15 or 20 years earlier than did cellular, and true cellular-like products would have appeared in the mid- and late-70s. Three firms would have been competing in the wireless voice business. Near universal adoption of wireless phone service by consumers would have occurred in the early- or mid-1990s. Cable TV might never have penetrated urban areas, or would have penetrated much later, because the large number of wireless channels available to consumers would have taken away cable's unique features. The FCC would have been forced to deal with a wide range of interconnection issues much earlier than it did.

It would be a hard exercise to identify with any exactitude the consumer surplus foregone by our nation's failure to apply Coase's insights to the UHF spectrum in 1960. The above what-if scenario indicates that the benefits would have been at the very least in the hundreds of billions of dollars.[28]

Conclusions

The spectrum rights regime in New Zealand reflects Coase's insights and, most probably, would not exist without his work. Reflecting history and technological factors, the New Zealand system does not apply a property-rights approach to all spectrum. But, a significant fraction of the most valuable spectrum has been privatized under a property-rights regime. The next few decades may allow us to see if such true property rights provide significant advantages over the more attenuated rights packages employed in other nations. Coase's insights also had substantial impact on the development of policy in the United States. But, my hypothetical world in which Coase's insights were broadly applied to the UHF spectrum in 1960 illustrates how massive the benefits of more efficient institutions for the management of the spectrum could have been and might still be in the future.

[28] See "Estimate of the Loss to the United States Caused by the FCC's Delay in Licensing Cellular Telecommunications," Jeffrey Rohlfs et al., NERA, November 1991, which estimated that a 10-year delay in licensing cellular cost $86 billion. See also, "Valuing the Effect of Regulation on New Services in Telecommunications," Jerry Hausman, Brookings Papers on Microeconomics, 1997, which indicates that the *annual* welfare losses of such a 10-year delay in cellular would have been $24 and $50 billion in 1983.