

The Unfinished Radio Revolution: New Approaches to Handling Wireless Interference

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EXECUTIVE SUMMARY

Over the last few decades, the Federal Communications Commission has spearheaded a critical rethinking of its radio spectrum management policies. This undertaking presages a wholesale abandonment of command-and-control regulation in favor of new approaches that emphasize various combinations of flexible use, market-based allocation, and open access to spectrum. However, although there is general accord over the desirability of moving beyond command-and-control, there remains considerable disagreement about how to best achieve this. One extreme calls for a commons-like approach that promotes shared and open access to spectrum, while the other argues for a property rights regime that facilitates welfare maximizing transactions.

On November 12, 2010, eleven academics, public interest advocates, members of industry, and policy makers gathered in Washington, D.C., to discuss the future of radio spectrum management. Specifically, participants were asked to address how radio-operating rights should be defined, assigned, and enforced in order to obtain the maximum benefit from wireless operations. From this stepping-stone, the participants identified a wide variety of challenges facing the FCC and proposed a variety of intriguing solutions. Although there was no grand consensus, four overarching themes emerged from the discussion: (1) radio rights must be defined clearly, predictably, and objectively; (2) there is a wide range of views regarding the need to define harmful interference; (3) private dispute resolution and negotiation should be broadly enabled by the FCC, especially with an eye towards facilitating market transactions; and (4) the FCC should articulate specific policies to address institutional constraints and reforms, such as dealing transparently with decisions about the equitable distribution of rights.

I. INTRODUCTION: THE FUTURE CHALLENGES OF RADIO SPECTRUM MANAGEMENT

The regulatory landscape superintended by the FCC is rapidly changing. Most recently, the National Broadband Plan proposed to repurpose and allocate vast swaths of the radio spectrum to facilitate the growth of new wireless services. Complicating this issue, the FCC is also in the process of shifting away from command-and-control regulation, which has characterized the licensing of services such as broadcast radio and television in years past, towards policies that promote, *inter alia*, open access, shared or flexible use, as well as, market-based allocation of spectrum. Today, while there is a general agreement that these policies will play a critical role in the future of spectrum management, many of the specific details still need to be worked out.

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On November 12, 2010, a group of academics, public interest advocates, members of industry, and policy makers gathered at the Information Technology & Innovation Foundation in Washington, D.C., to discuss the challenges of radio spectrum management.¹ The half-day public conference – a follow up to a closed summit on cross-channel interference held by the Silicon Flatirons Center last year² – proceeded in three phases: three speakers introduced and described the most pressing problems in radio regulation, and subsequently, two panels discussed potential solutions to these problems. The panelists and speakers also submitted separate position papers that more thoroughly outline their remarks and discussion at the conference proper.³

The introductory portion of the conference was devoted to providing a broad overview of the present state of spectrum management, describing many of the problems that have arisen, and discussing some of the technical reasons for these problems.

A. Introduction to Rights Management

Pierre de Vries, Senior Adjunct Fellow at the Silicon Flatirons Center and Research Fellow at the Economic Policy Research Center, provided an introduction to the regulatory challenges being addressed by the conference.⁴ For example, there is an exponentially increasing need for more spectrum to meet the demands of new wireless services and their attendant technologies. Moreover, efforts to meet this increase in demand have resulted in more intensive use of spectrum, which, in turn, is leading to and will likely continue to lead to increased instances of interference conflicts between radio licensees. De Vries pointed to three questions that, in his opinion, characterize the different schools of thought regarding wireless regulation. First, how should the FCC separate its legislative and judicial functions? In the prototypical scenario, regulators begin by defining and assigning the rights of various users, who subsequently commence operations based on these rights. It is at this point that problems typically arise, and that regulators must step in to enforce the rights, but when they do, is this an exercise of legislative or judicial authority? Second, how should policy makers address the tension between legacy and novelty uses? The FCC has a long-standing policy of protecting absolutely incumbent uses from new entrants' operations. But, with the new emphasis on encouraging innovation, should the FCC revisit this policy? Third, how do regulators define the benefits of spectrum use, and how do they orient spectrum policy to maximize them? Here, lenses through which to view the problem include the efficient allocation of resources, maximizing consumer demand, and productivity growth.

In addition, De Vries thought there are two critical premises to the future of spectrum management. First, the overarching goal of spectrum policy should be to maximize concurrent operations as opposed to minimizing the incidents of harmful interference. And second, the particular balance of entitlements between licensees that

¹ The conference was presented by the Silicon Flatirons Center, IEEE-USA, The Information Technology & Innovation Foundation, CTIA: The Wireless Association, The New America Foundation, and the Federal Communications Bar Association.

² See Pierre de Vries, *Defining Inter-channel Operating Rules: A report on a Silicon Flatirons Summit on Information Policy* (2009), <http://www.silicon-flatirons.org/documents/misc/OOBSummit/Inter-channelSummitReportv1.0.1.pdf>.

³ A compendium of the position papers is available on the Silicon Flatirons website at <http://www.silicon-flatirons.org/documents/conferences/2010.11.12-862/Compendium.pdf>

⁴ Video of his comments is available at <http://www.youtube.com/watch?v=vxJLHgEWIDE#t=32m05s>.

represents the social welfare optimum when it comes to radio operating rights does not remain static. Accordingly, the primary focus of spectrum policy should be on facilitating transactions that allow for the appropriate *ex post* adjustments of the rights and entitlements provided by a license in order to maintain the optimum.

Wrapping up his overview, De Vries articulated a framework for managing radio rights based on what he called the “Three Ps”: probabilistic, permissions, and protections.⁵ First, spectrum rights should be defined in a *probabilistic* manner because the propagation of radio signals is constantly changing. Second, the *permissions* that govern the right to transmit should be based exclusively on the resulting field strengths, and not the powers at the antennae. Third, receivers should be afforded certain *protections* through regulatory guarantees that transmission permissions will not exceed certain ceilings. Defined in such a way, there is no need to define harmful interference in entitlements, although the question of “harm” may arise during rights development and adjudication. Turning to procedural matters, De Vries recommended that the regulator: stipulate remedies (*e.g.*, injunctions or damages) when entitlements are issued; only adjust parameter sets at license renewal; and clearly separate rulemaking from adjudication.

B. Increasing Demand for Spectrum

Robert Atkinson, President of the Information Technology & Innovation Foundation, described the challenges posed by the ever-increasing demand for spectrum. As he explained, new business models will need abundant radio resources because data traffic from Smartphone and mobile Internet use is exploding. For example, a 5 MB download contains as much data as a one hour phone call; a single YouTube video is the equivalent of 5,000 text messages. Indeed, many industry analysts predict data traffic rates will increase as many as 22 to 47 times by 2014. According to Atkinson, even if this estimate is overstated by half, meeting the increased demand will still be a big challenge.

C. Interference

Interference is the primary technical problem that limits the ability of multiple parties to use spectral resources. Dale Hatfield, Executive Director of the Silicon Flatirons Center and former Chief Technologist for the FCC, provided a technical overview of the various interference mechanisms that limit concurrent uses of spectrum.

As Hatfield explained, radio transmissions can be separated along three dimensions: time, space, and frequency. Spillover at boundaries of each of these dimensions can lead to interference. But, it is critical to understand that interference occurs at the radio receivers themselves, and is not caused by radio waves interfering with each other in the air.

Broadly speaking, interference mechanisms can be grouped into three categories: in band, out of band, and time-based. However, in order to understand interference, it is first important to understand a little about receiver architecture. Most radio devices employ two sequential filters at the receiver. The first, called the band filter, selects the

⁵ See Pierre de Vries & Kaleb A. Sieh, *The Three Ps: A Resulting Energy Approach to Radio Operation Rights* (forthcoming), available at <http://papers.ssrn.com/abstract=1704194>.

desired “band” out the entire radio spectrum (*e.g.*, television broadcasts instead of FM radio). The second, called the channel filter, selects the desired “channel” (*e.g.*, Fox instead of NBC).

i. In Band Interference. In band interference occurs primarily through two mechanisms: co-channel interference and adjacent-channel interference. Co-channel interference happens when a receiver is unable to detect the desired signal because a second transmitter is simultaneously broadcasting at the same frequency (*i.e.*, on the same channel). Adjacent-channel interference occurs when a receiver is unable to detect a weak signal from a far-away source because it is overwhelmed by a strong signal from a nearby source broadcasting at a similar frequency (*i.e.*, on the adjacent, or “next door,” channel). However, separating the various transmissions in the space and frequency dimensions can eliminate both of these interference mechanisms, but doing so creates “waste spectrum” – through unused guard bands and white spaces.

ii. Out of Band Interference. Out of band interference occurs because band filters are not perfect, and some energy at outside frequencies gets through. Under the right conditions, this energy (through a non-linear process called intermodulation) can interfere with the desired in-channel signal. In addition, high out of band energy can also affect the gain of a receiver, and thus suppress the desired in-band signal.

iii. Interference in Time. As mentioned before, radio signals can also be separated in the time dimension. The simplest example is the day/night sharing of AM Radio channels (*i.e.*, where one station broadcasts during the day and another broadcasts at night). However, more modern technologies, such as radio pagers, TDMA phones, and devices reliant on dynamic spectrum assignment also use time separation to avoid interference. Because temporal signals cannot be attenuated instantaneously, it is possible that two signals can overlap in time, leading to interference at the receiver.

With all forms of interference, the primary challenge for policy makers is to manage the various interference mechanisms to get the maximum benefit from spectrum. However, as Hatfield emphasized, this is further complicated by the fact that interference can occur anywhere within the geographic service area, not just at the boundaries; the perceived threats of interference are often asymmetric; the interfering services may be based on very different technologies; there may be a substantial number of players (for example, various GPS services have millions of users); and the stakeholders may have vastly divergent needs, incentives, and cultures (*e.g.*, public safety is animated by different concerns than a for profit industry). Nonetheless, as more and more people and services come to rely on spectrum, interference problems will become more acute.

II. PANEL ONE

The first panel was moderated Ari Fitzgerald, a partner at the law firm of Hogan Lovells LLP. He asked the panelists for their thoughts on how spectrum should be allocated while simultaneously mitigating adjacent band interference and minimizing the associated costs.

Evan Kwerel⁶ argued that the real challenge facing spectrum management is that it takes place in a dynamic world. Accordingly, there need to be allowances for

⁶ Kwerel is a Senior Economist in the Office of Plans and Policy at the Federal Communications Commission. The position paper, Evan Kwerel & John Williams, *The Spectrum Regulators*

efficiency enhancing changes. Indeed, since the 1990s, the FCC has recognized this and has allocated spectrum in a flexible way (one example being PCS licenses). However, there is still the problem of sequential change – the FCC cannot allocate all frequencies simultaneously, but rather, has to do it piece by piece. One potential approach to solving problems caused by this sequential approach is for the FCC to revisit its policy of protecting incumbent uses from *any* interference as a result of rule changes. According to Kwerel, because incumbents are protected absolutely when a new user enters the field (*i.e.*, from a sequential change), the incumbents have no incentive prior to the new entry to implement efficient mitigation that could help resolve interference problems from future uses; if anything, the incentive is exactly the opposite. Consequently, he would have the FCC establish default assumed uses for adjacent bands when making spectrum allocations and require that incumbents internalize the cost of protecting themselves against interference from these hypothetical uses.

Kwerel pointed to the conflict between the WCS and SDARS services as an example of just this kind of problem. There, spectrum was allocated to SDARS before WCS, and because of this, SDARS had no incentive to build receivers that could tolerate *any* service or use in the adjacent bands. This resulted in satellite radio providers (SDARS users) building receivers that made the adjacent band effectively unusable. As Kwerel emphasized, another way to think about this is that there were market failures. First, not all rights had been assigned, which precluded Coasean bargaining between the licensees (*i.e.*, the parties “can’t negotiate if the other license hasn’t been allocated”). Second, there were high transaction costs, which frustrated negotiations. In short, had there been a default assumption about uses in the WCS band, SDARS would have been required to internalize the costs of building receivers that could tolerate adjacent users and this problem would have been far less severe.

Michael Calabrese⁷ argued that it is imperative to take into consideration where the world is heading as radio rights are redefined. At present, radio rights reflect the world as it existed fifty years ago, when spectrum was plentiful and technology was primitive. In that world, primitive technology could be protected by exclusive use because there was always more spectrum available for new technologies. However, this is not the case today. Increasing demand is placing enormous stress on wireless businesses, and policy makers cannot maintain the status quo when it comes to spectrum allocation; current policy will likely only produce a 4-fold increase in available spectrum. Use of dynamic antennas, however, might produce a 44-fold increase in available spectrum, and spectrum reuse could produce an estimated 400-fold increase. Accordingly, policy choices should aim to foster more intensive sharing of spectrum.

Calabrese maintained that in order for radio rights to facilitate access to shared and dynamic spectrum they need to be: (1) definite; (2) transparent; and (3) oriented towards more intensive use. In this way, radio rights should be more like property when

Dilemma in a Dynamic World: Limiting Interference without Stifling Innovation, is available at <http://www.silicon-flatirons.org/documents/conferences/2010.11.12-862/KwerelWilliams.html>.

Video of his comments is available at

<http://www.youtube.com/watch?v=vxJLHgEWIDE#t=45m50s>.

⁷ Calabrese is a Senior Research Fellow at the New America Foundation. His position paper, Michael Calabrese, *The Need for Well-Defined yet Non-Exclusive Radio Operating Rights*, is available at <http://www.silicon-flatirons.org/documents/conferences/2010.11.12-862/CalabreseShort.html>. Video of his comments is available at

<http://www.youtube.com/watch?v=vxJLHgEWIDE#t=1h03m48s>.

it comes to providing certainty, while simultaneously less like property, allowing for flexibility and shared access. In order to do this, the FCC needs to create explicit transmission rights on a band-by-band basis that indicate protection levels in probabilistic terms, and moreover, these rights need to be accessible through a public database so that potential licensees or device manufacturers can identify and take advantage of unused spectral capacity.

Gregory Rosston⁸ observed that there is, in fact, a great deal of consensus within the spectrum community. In particular, there is wide agreement about the importance of Coase, but it is important to think about how Coase, and the problem of transaction costs, applies to changing circumstances. According to Rosston, Coase explained that when there are no transaction costs, the market automatically finds the efficient solution. In reality though, there are transaction costs and free-rider problems. Thus, the most critical challenge facing policy makers is how to get closer to a perfect Coasean world by minimizing transaction costs.

Along these lines, it is crucial to recognize that there are three main players when it comes to radio rights: transmitters, receivers, and the government. Traditional Coasean analysis only takes into account the first two, but licensees will also negotiate with the government if they believe that they can get a better deal. For example, during auctions, bidders will often work towards being given poorly defined rights when negotiating with the FCC in order to keep the costs of a license at a minimum, and then, after the auction, use lawyers to redefine and increase the certainty of those rights. Accordingly, the backstop role the government plays in setting rules is important, and the FCC needs to create clear rights that are difficult, if not impossible, to expand through further negotiations with the government. This will force the parties to negotiate amongst themselves. Likewise, the FCC also needs to consider ways to reduce the number of parties to negotiations. For example, in open entry bands, with whom does a user negotiate in order to increase the power of its transmissions? The system must take into consideration how to coordinate large numbers of users and quickly adopt new technology.

Bruce Jacobs⁹ remarked that he was generally in agreement with the other panelists. However, when it came to the WCS and SDARS bands, arguably they were allocated simultaneously, and the real question might be which party was trying to game the system.

As for radio rights, Jacobs felt the key challenge was to improve predictability – particularly for clients who want to innovate but need to protect their investments. As an

⁸ Rosston is a Professor at Stanford University where he teaches courses on competition policy and strategy, intellectual property, and writing and rhetoric. The position paper, Gregory Rosston & Scott Wallsten, *Economic Principles for Ex Ante Rules for Radio*, is available at <http://www.silicon-flatirons.org/documents/conferences/2010.11.12-862/RosstonWallstenShort.html>. Video of his comments is available at <http://www.youtube.com/watch?v=vxJLHgEWIDE#t=1h12m45s>.

⁹ Jacobs is a partner at the law firm of Pillsbury Winthrop Shaw Pittman LLP, where he focuses on counseling companies developing new technologies that are regulated by the Federal Communications Commission. His position paper, Bruce Jacobs, *How Should Radio Operating Rights be Defined, Assigned, and Enforced in Order to Obtain the Maximum Benefit from Wireless Operations?*, is available at <http://www.silicon-flatirons.org/documents/conferences/2010.11.12-862/JacobsShort.html>. Video of his comments is available at <http://www.youtube.com/watch?v=vxJLHgEWIDE#t=1h21m12s>.

example, he noted that, at one time, comparative hearings had generated an enormous amount of precedent, and that this precedent had helped to facilitate licensing procedures. Accordingly, the FCC should move towards a jurisprudence – akin to a restatement of interference – that gives more predictability. Rather than resolving problems on a case-by-case basis, the FCC should focus on articulating broadly applicable general principles. Jacobs said he understood why the FCC has shied away from this challenge, but felt it needs to start moving in this direction.

Ellen Goodman¹⁰ asked, “Where is there consensus?” She felt there is general agreement on: how additional spectrum needs to be made available through greater sharing and more intensive use; that there must be exclusive and shared rights; there are going to be more interference conflicts; and that some amount of *ex ante* zoning by regulators is going to be necessary. Nonetheless, she said, there are also political realities impacting the ability of regulators to effect these changes. First, there will be relentless political pressure to raise revenue from license auctions. Second, there are equitable concerns that enter into the political calculus and “confuse” what economists may believe are the ideal solutions. For example, even though the economic analysis is generally indifferent – in a purely Coasean world – to whether incumbent broadcasters are given a windfall benefit in order induce transition to flexible use or to whether auction revenues go entirely to the Treasury or for other purposes, politicians and parties care about the choices. Accordingly, said Goodman, policy makers have to carefully define the equities involved and make some choices without pretending that they do not matter so long as spectrum ends up in the hands of the highest valued use.

In addition, the FCC should address the fact that all operating rights are not completely and exhaustively assigned when a license is given. If all rights were assigned, parties would be forced to negotiate amongst themselves to get additional rights, but because the government retains many of the rights, the parties can simply go to the government in order to get more. Consequently, the FCC needs to set clear rules for how parties can go about getting these unassigned rights. This raises a series of complicated questions such as: what rights should incumbents be entitled to; should all entry be paid for; what if an innovator lacks the capital to purchase the necessary rights but can utilize the spectrum more efficiently than anyone else; and can heterogeneous regimes, such as exclusive use and open entry, coexist? As Goodman explained, she likes Kwerel’s idea of default assumed uses, but what happens when the default has to be changed?

As a final thought, Goodman said she would like to see the FCC make a choice about interference entitlements and “jump off the diving board.” Whatever the choice, she said, it is clear that absolute freedom from even “harmful” interference cannot be an entitlement anymore.

¹⁰ Goodman is a Professor of Law at Rutgers University-Camden, specializing in the law of information technology, including telecommunications, media and intellectual property. Her position paper, Ellen Goodman, *Progress Toward Rational Spectrum Rights: Are We Getting Anywhere?*, is available at <http://www.silicon-flatirons.org/documents/conferences/2010.11.12-862/GoodmanShort.html>. Video of her comments is available at <http://www.youtube.com/watch?v=vxJLHgEWIDE#t=1h26m45s>.

III. PANEL TWO

The second panel was moderated by Cheryl Tritt, a partner at the law firm of Wilkinson Barker Knauer LLP.

Michael Marcus¹¹ began the panel by arguing that innovation is not just the key to the health of the telecommunications section, but to the U.S. economy as a whole. As he explained, many innovative business models and operations depend on the latest wireless technologies. In most countries, central planning (*i.e.*, Soviet-style command-and-control) regulates access to these technologies, but in the U.S., the FCC has been instrumental in using market forces and deregulation to allocate spectrum. There is still a problem though, because at the core of the Commission's approach is a harmful interference standard that results in endless interference proceedings prior to licensing. These protracted hearings severely limit the ability of new entrants to access the capital markets, which ultimately hampers innovation.

To remedy this, Marcus proposed that the FCC explicitly state, but not require, what is expected of new entrants in terms of protecting incumbents from interference, and that this should serve as a starting point for interference proceedings. Along these lines, he said, the FCC should: (1) identify which propagation models are the most appropriate; (2) determine how much interference is acceptable; and (3) specify a default minimum spacing between receivers. He felt it may be unrealistic to expect the FCC (or NTIA) to have the technical expertise necessary to accomplish this challenge, and noted that other federal agencies routinely solicit technical expertise from the National Academy of Sciences (NAS). One approach he identified was for the FCC to refer these technical challenges to the NAS initially and then review that body's findings via a rulemaking of its own. In fact, according to Marcus, there is precedent for doing just this: both Part 28 and Part 65 of the FCC's rules grew out of work that began at NAS in the 1970s.

Charla Rath¹² thought that theory needed to be complemented by practice when it comes to spectrum rights management. For example, PCS and cellular bands actually do allow licensees to negotiate rights among themselves. Consider the Verizon network, she said, which reaches 289 million people in the United States, and in addition to the cellular licenses, also requires 10,000+ cell sites and a number of microwave licenses. With such a large number of licenses, each with its own set of boundary issues, spectrum management is not so much a question of one large intractable problem, but a series of smaller day-to-day concerns that arise in operating a vast network with many constituent parts. In the field, PCS providers routinely enter into agreements with one another without ever informing the FCC. Sometimes this is because there is an interference issue, but other times a user might just want additional rights to make some aspect of its service work, which usually can be accomplished quickly and easily between the respective

¹¹ Marcus is an Adjunct Professor at Virginia Tech's Department of Computer and Electrical Engineering and the Director of Marcus Spectrum Solutions LLC, a consulting firm on wireless technology and spectrum policy, and formerly held a number of key technical positions with the FCC. His position paper, Michael J. Marcus, *Radio Rights and Wireless Technical Innovation*, is available at <http://www.silicon-flatirons.org/documents/conferences/2010.11.12-862/MarcusShort.html>. Video of his comments is available at <http://www.youtube.com/watch?v=vxJLHgEWIDE#t=2h15m20s>.

¹² Rath is the Vice President of Public Policy at Verizon. Her position paper, Charla M. Rath, *Defining Radio Rights—Theory and Practice*, is available at <http://www.silicon-flatirons.org/documents/conferences/2010.11.12-862/RathShort.html>. Video of her comments is available at <http://www.youtube.com/watch?v=vxJLHgEWIDE#t=2h24m33s>.

licensees' engineers. Importantly, she said, even where this approach fails, a licensee is still unlikely to go to the FCC because there are other ways to achieve its goals. In fact, the only time a company is likely to rely on the FCC is where it needs "backup" to enforce already clearly defined rights (e.g., a company might turn to the FCC where a repeater on a Manhattan skyscraper disables hundreds of cell sites). As Rath stressed, the important takeaway is that rights negotiation is not just a theoretical exercise.

Harold Feld¹³ asked what happens when things go catastrophically wrong, because he felt it is impossible to build rules based on models that are not robust enough to account for reality. As an example of catastrophic failure, Feld pointed to the 800 MHz rebanding, explaining that this scenario was as close to Coase as the FCC has ever come, but problems still occurred as things were "ramped up." First, he said, the "bad actors" did not necessarily realize that they were such; and second, there are no set of well-defined rights that will compensate for the incentive to do bad. He then asked the group to consider a Verizon rollout, and asked what might happen if a significantly large number of cellular handsets in the market began to interfere with public safety. He thought the "right answer" in that case might end up being politically impossible.

Along these lines, according to Feld, the FCC should consider two models that may be useful in preparing for the possibility of catastrophic failure. First, the FCC could apply the doctrine of adverse possession to the radio context. Like real property law does, the FCC could acknowledge that an adverse possessor has rights if his or her use has been open and notorious for a long enough period of time. Moreover, the FCC might announce what priorities and principles will govern these decisions (for example should public safety uses trump commercial? Or is increasing treasury revenue of primary importance). Second, the FCC could implement "enforcement in a box." This is a technical approach that would require each transmitter in the market to communicate with an FCC database that would tell the transmitter how to behave. With this technology, the FCC would be able to switch off offending devices in the field *en masse*. Obviously, each of these solutions has associated costs, but it is important to recognize that catastrophic failure happens from time to time.

Thomas Hazlett¹⁴ explained that his approach might be orthogonal to those of the other panelists. To his mind, there are three sources of information about optimal rights usage and the problem of drawing boundaries: (1) practical regulatory experience; (2) spectrum transactions in the market (particularly robust secondary markets); and (3) the property rights literature. With regard to practical experience, he felt the most important lesson is that complete precision in defining property borders is not only unnecessary, but also deleterious, because clarity is expensive. As for secondary markets, regulators have accumulated significant amounts of evidence that the key to efficiency is reducing the number of borders licensees share with other licensees. And, by analogy to property rights, it becomes apparent that it is not appropriate to minimize interference, but to maximize welfare. However, since it is impossible for the FCC to maximize welfare on

¹³ Feld is the Legal Director of Public Knowledge. His position paper, Harold Feld, *Confronting the Problem of Adverse Possession in Spectrum Rights*, is available at <http://www.silicon-flatirons.org/documents/conferences/2010.11.12-862/FeldShort.html>. Video of his comments is available at <http://www.youtube.com/watch?v=vxJLHgEWIDE#t=2h33m27s>.

¹⁴ Hazlett is a Professor of Law and Economics at George Mason University School of Law with a focus on telecommunications law, and was formerly the Chief Economist for the FCC. Video of his comments is available at <http://www.youtube.com/watch?v=vxJLHgEWIDE#t=2h44m30s>.

its own through central planning, it is critical to get the rights out into the marketplace so that the optimal solution can be “discovered” by the rights holders themselves.

Hazlett then discussed two examples. First, he said, consider the dichotomy at the heart of the Spectrum Policy Task Force Report. In the report the FCC says two seemingly contradictory things: that, going forward, rights need to be exhaustively defined or the market will not be able to handle transactions costs; and, at present, look at how great the spectrum market is working. What this really shows is that rights can be defined vaguely in a technical sense and yet the market is still able to function. Looking to a separate area of law, this happens all the time with contracts: courts simply figure out how parties would have negotiated a solution based on the language and intent of a contract. In this sense, it is appropriate to think of defining of rights, and the associated problem of specifying harmful interference, as analogous to an incomplete contracting problem.

Second, he said, consider the formation of Nextel: was this Coase? Before Nextel there were massive border problems from interleaved licenses and “irresponsible” public agencies, but Nextel was able to “put Humpty Dumpty back together again.” Importantly, Nextel did not achieve this by discovering a new definitional solution; all that it took were market transactions. Accordingly, Hazlett argued that the FCC should focus on bringing spectrum rights into the market to allow for transactions, resolve border disputes by awarding rights to the parties who can most rationally address them, and allow for combination bidding to solve the definitional problem.

IV. CONCLUSION

The conference concluded with some brief remarks from Pierre de Vries. He observed four main themes that he thought had emerged from the foregoing discussion: (1) radio rights must be defined clearly, predictably, and objectively; (2) there is a wide range of views regarding the need to define harmful interference; (3) private dispute resolution and negotiation should be broadly enabled by the FCC, especially with an eye towards facilitating market transactions; and (4) the FCC should articulate specific policies to address institutional constraints and reforms, such as dealing transparently with decisions about the equitable distribution of rights. In addition, the sponsors thanked the panelists and audience for their participation and attendance.