

Possible Legal Implications of Disruptive Technologies: Select Examples

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Abstract

LightSquared had an innovative business model – integrate its existing satellite communications services with a ground-based 4G-LTE network utilizing the same radio band as its satellites. Unfortunately, that band was in close proximity to the primary GPS frequency. The GPS community feared the results if spillover from the stronger LightSquared signals overloaded or saturated GPS devices. Ultimately, after many attempts to modify and restructure its business structure and the use of its spectrum, LightSquared received court approval for a bankruptcy loan while it attempted to figure out an exit strategy. Unresolved interference concerns shut the company down, despite its initial innovative and spectrum-efficient promise.

Kymeta recently performed a game-changing demonstration of its disruptive technology. The company, operating with an experimental license, successfully demonstrated bi-directional high-speed Internet connectivity with a Ka broadband satellite using its metamaterials antenna. The antenna uses artificial materials that are engineered to manipulate electromagnetic radiation, resulting in very targeted beam steering. The precision can be achieved using significantly smaller hardware than traditional parabolic disc antennae and/or mechanical terminals or phased array antennae and with the ability to connect literally anywhere in the world. But, will Kymeta's breakthrough be practical in the presence of interfering radio signals that might be able to externally modify the beam direction? Or could the beam create interference for a neighbour use of spectrum?

Clearly, technologies are changing the method and manner that spectrum is utilized and regulated today. Recently, the Canadian Radio-television and Telecommunications Commission (CRTC) scuffled with Netflix on issues of governance. The paper examines the current ITU and FCC regime, as well as the documentation available regarding the LightSquared case, in an effort to ascertain whether and how disruptive technologies are putting the current spectrum management regulatory scheme to the test. It is possible to glean some anecdotal lessons useful when applied to other disruptive technologies in space; the paper will conclude with the author's recommendations.

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I. Introduction

The spectrum environment has become increasingly dynamic in recent years. Where once the telecommunications landscape was populated with a few incumbent actors utilizing embedded distribution channels, now there are multiple modes of information dissemination requiring fewer layers to access.¹ Disruption is viewed as a positive force and transformation as a positive result. This love affair with disruption and innovation can be found in multiple contexts.²

The paper explores the relationship between disruption and innovation. It proceeds to present an example of a technology that challenged traditional concepts of harmful interference and failed. Those concepts are identified in both an international and domestic context. However, this article is not merely a cautionary tale. Rather than accept the fate of LightSquared's failure to proceed with an innovative business plan as the only possible outcome, the paper continues by exploring theories and responses that provide a more hopeful future for disruptive innovation when it runs up against incumbent uses with arguable social value. It ends with comments and recommendations for policy makers and regulators, in the spectrum management context but also the larger paradigm that includes other disruptive technologies that run the risk of under utilization.

II. Relationship Between Disruption and Innovation

Disruptive technologies are considered innovations that can create new markets, eventually displacing or disrupting those that exist.³ In its report "Disruptive technologies: Advances that will transform life, business, and the global economy", the McKinsey Global Institute lists twelve potentially economically disruptive technologies" and includes applications that range from mobile Internet to renewable energy to 3D printing.⁴ The mobile Internet is defined as high-speed wireless connectivity (WIFI) as well as applications utilizing WIFI, such as smartphones and tablets.

At one time, disruption was an accepted by-product of innovation. Presently, disruption of the status quo has become a primary goal.⁵ For all the positive impact made by many of these creative new technologies, they come with cost. Some costs are purely societal and cultural, such as compromised privacy rights,⁶ and some costs are economic, as in the financial implications

¹ Konstantinos Stylianou, "An Innovation-Centric Approach of Telecommunications Infrastructure Regulation" 16 Va J L Tech 221 at 222.

² "Disruptive technologies: Advances that will transform life, business, and the global economy" (McKinsey Global Institute 2013) at 5.

³ Clayton Christensen "The Innovator's Dilemma" (First Harper Business 1997).

⁴ McKinsey report, *supra* note 2 at 5.

⁵ Neal Katyal, "Disruptive Technologies and the Law" 102 Geo. L.J. 1685 (2013-2014).

⁶ *Ibid.* at 1686.

of infrastructure improvements that may be necessary to make mobile Internet available globally in light of the current spectrum constraints.⁷ The inadequacies of the current spectrum management scheme also costs society, by impinging upon the ultimate benefits that efficient spectrum use would allow. It is this last cost with which the paper is concerned.

III. Spectrum Challenges and Examples

Lightsquared

LightSquared had a dream: to be the first US-wide 4G LTE network with satellite coverage.⁸ The company was formed by acquiring SkyTerra assets, including spectrum. First heralded as a serious contender against embedded giants such as ATT and Verizon, LightSquared planned to sell its services wholesale only, thus not directly competing with the incumbents but offering more options in the marketplace.⁹ Unfortunately, it would utilize a block of frequencies located near the band used by the US Global Positioning System (GPS).¹⁰

Early in the company's timeline, experts identified interference issues as a possible deal breaker despite the fact that the company planned to operate within the parameters assigned by the US Federal Communications Commission (FCC).¹¹ In January 2011, LightSquared obtained a conditional waiver that would permit it to utilize a terrestrial component within specified parameters, in order to service areas problematic for satellite communications (like mountain ranges or forests).¹² The waiver was conditioned upon the company's ability to address and satisfy the interference concerns of other spectrum users, specifically GPS. It is important to note that the FCC appeared to "fast-track" procedure for this ruling, allowing only one week for public

⁷ McKinsey report, *supra* note 2 at 38.

⁸ "Nationwide LTE Broadband Network" LightSquared website available at: <http://www.lightsquared.com/what-we-do/network/> (date accessed: 8 January 2015).

⁹ Marguerite Reardon, "LightSquared: the answer to U.S. wireless competition?" CNET Magazine (21 April 2011) available at: <http://www.cnet.com/news/lightsquared-the-answer-to-u-s-wireless-competition/> (date accessed: 15 December 2014).

¹⁰ Katherine Burton, et al., "LightSquared: Phil Falcone's Dream Fades" Bloomberg Businessweek: Markets & Finance (3 May 2012) available at: <http://www.businessweek.com/articles/2012-05-03/lightsquared-phil-falcones-dream-fades> (date accessed: 8 January 2015).

¹¹ *Ibid.*; "LightSquared and GPS – The Facts" available at: <http://www.lightsquared.com/documents/LightSquared%20GPS%20Timeline%20and%20Fact%20Sheet%2006-08-11.pdf> (date accessed: 11 January 2015).

¹² Gavin Schrock, "A \$10,000 gigabyte: Why we shouldn't mourn for LightSquared" GigaOm (1 March 2014) available at: <https://gigaom.com/2014/03/01/a-10000-gigabyte-why-we-shouldnt-mourn-for-lightsquared/> (date accessed: 8 January 2015).

comment rather than the more usual thirty days.¹³ This merely incensed the users of nearby spectrum.

The GPS community mobilized against LightSquared. GPS users rely upon equipment that is not sophisticated enough to discern LightSquared's nearby and powerful signals from those within GPS' spectrum.¹⁴ LightSquared's principal took the position that the problem was GPS' to solve as those unlicensed users were encroaching upon his licensed use of spectrum.¹⁵

GPS device manufacturers could have avoided the drama by equipping the receivers with filters costing as little as five cents per unit.¹⁶ But that is not what ensued. Instead, a hue and cry went out upon the land. A letter writing campaign was lodged; high-level support was given to GPS in its efforts to shut down the upstart service provider.¹⁷ Even international NGOs supported GPS against LightSquared.¹⁸

The final and ultimate blow came from the National Telecommunications and Information Administration (NTIA), the agency responsible for advising the Executive Branch on telecommunications and information policy issues and managing the federal use of spectrum, essentially performing for the government the functions that the FCC performed for the private sector. After its own independent evaluation of the testing and analysis performed by multiple federal agencies (including the FCC), the NTIA came to the scathing conclusion that "LightSquared's proposed mobile broadband network will impact GPS services and that there is no practical way to mitigate the potential

¹³ Azam Ahmed, "Loss of a Wireless Dream Caps a Fast Fall From Grace" Deal Book: NY Times (15 February 2012) available at: <http://dealbook.nytimes.com/2012/02/15/loss-of-wireless-dream-caps-a-fast-fall-from-grace/> (date accessed: 8 January 2015).

¹⁴ Deborah D. McAdams, "LightSquared Blasts GPS Receiver Quality" TV Technology (30 June 2011) available at: <http://www.tvtechnology.com/prntarticle.aspx?articleid=209539> (date accessed: 14 September 2014). In fact, the company asserted that legacy GPS equipment had perhaps been deliberately designed below available capability because manufacturers and service providers glibly assumed that there would be no adjacent terrestrial transmissions.

¹⁵ Burton, *supra* note 10.

¹⁶ McAdams, *supra* note 12.

¹⁷ Letter to Mr. Julius Genachowski, Chairman FCC, from John Porcari, Deputy Secretary Department of Transportation and William Lynn III, Deputy Secretary of Defense, dated 25 March 2011, requesting clarification and further study and alleging that they had not been included in LightSquared's initial work plan. To be fair, some letters of support were also sent. See letter from Jonathan Bartsch, a volunteer firefighter in a mountainous community, to Marlene Dortch, Secretary FCC, dated 20 May 2011, in support of LightSquared's technology as an aid to better communication between members of fire departments in the mountains.

¹⁸ Letter from John Wilde, CEO European Positioning Navigation and Timing Industry Council to Julius Genachowski, Chairman FCC, dated 4 July 2011.

interference at this time.”¹⁹ The FCC moved to suspend LightSquared’s plan indefinitely.

Thus, the chain reaction of dominos began to fall. LightSquared investors began to pull support.²⁰ The company tried to regroup, offering to allay the interference concerns by changing the frequency of the bandwidth it had planned to use for its satellite service to frequencies near NOAA’s spectrum used for weather balloons.²¹ One investor tried to leverage a buy out;²² LightSquared sued other stakeholders.²³ Ultimately, the company filed for Chapter 11 reorganization in the US Bankruptcy court.²⁴ Sadly, the saga is on going.²⁵

The bigger questions inherent in this tale ask less about the politics and timing of the LightSquared scenario and focus instead upon the issue of the effect of permitting the shut down of a legally and economically viable business use that created competition and brought broadband to more users at an affordable price by a use dependent upon old technology. The GPS community relied upon arguments founded in harmful interference and roused the rabble with fear of possible outcomes. But this strategy, while successful for the GPS providers and device manufacturers, is not the only response available. And, it may have cost our society.

IV. Issues

To begin, this article is focused upon wireless, unlicensed usages such as GPS and smartphones, but these also include baby monitors and home security

¹⁹ Letter from Lawrence Strickling, Assistant Secretary NTIA, to Julius Genachowski, Chairman FCC dated 14 February 2012.

²⁰ Kelley Hodgkins, “LightSquared’s new strategy focuses on spectrum swap, not bankruptcy” into mobile (16 February 2012) available at: <http://www.intomobile.com/2012/02/16/lightsquareds-new-strategy-focuses-spectrum-swap-not-bankruptcy/> (date accessed: 11 January 11, 2015).

²¹ Phil Goldstein, “LightSquared could get FCC approval to use spectrum by year-end, witness says” Fierce Wireless (20 March 2014) available at: <http://www.fiercewireless.com/story/lightsquared-could-get-fcc-approval-use-spectrum-year-end-witness-says/2014-03-20> (date accessed: 11 January 2015); Steven Crowley, “LightSquared requests FCC permission to conduct test in support of a frequency swap” Blog (8 March 2012) available at: <http://stevencrowley.com/2013/03/08/lightsquared-requests-fcc-permission-to-conduct-tests-in-support-of-a-frequency-swap/> (date accessed: 11 January 2015).

²² Joseph Checkler, “LightSquared Says It Was Right to Shut Dish Chairman Charlie Ergen Out of Restructuring Plans” The Wall Street Journal (14 April 2014) available at: <http://www.wsj.com/articles/SB10001424052702304117904579501720979009880> (date accessed: 11 January 2015).

²³ LightSquared Inc. v. Deere & Co., 2014 WL 345270 (S.D.N.Y. 2014).

²⁴ In re: LightSquared, Inc., 513 B.R. 56 (S.D.N.Y. 2014).

²⁵ “Correction to LightSquared Week Ahead Story” Dow Jones Business News (9 January 2015) available at: <http://www.nasdaq.com/article/correction-to-lightsquared-week-ahead-story-20150109-00532> (date accessed: 11 January 2015).

systems. In the LightSquared context, the issue was interference, perceived to be harmful. “Harmful interference” is a term of art with legal consequence both internationally and domestically.

From the international perspective, what does harmful interference entail? The International Telecommunications Union (ITU) Constitution directs the Union to effect allocation and allotment “in order to avoid harmful interference” and to “eliminate harmful interference”,²⁶ while the Preamble of the Radio Regulations mandate stations to be “established and operated in such a manner as not to cause harmful interference” and to assist in the prevention and resolution of cases of harmful interference.²⁷ In fact, the Regulations hinge upon avoidance of harmful interference as a priority.²⁸ The Regulations define it as interference that “endangers the functioning of a radionavigation service or other safety services or seriously obstructs or repeatedly interrupts a radiocommunication service operating in accordance with the Radio Regulations.”²⁹

The ITU has a role in managing conflict when two stations or users are operating on the same frequency resulting in unacceptable interference and a responsibility to extend international protection from harmful interference. However, the LightSquared conflict was domestic. The Federal Communications Commission (FCC) is the federal agency that manages private spectrum within the US as per the Communications Act of 1934 and in accord with the ITU.³⁰ Section 305 of the Act preserves for the President the authority to assign federal (governmental) uses of frequency, powers that the President, in turn, has delegated to the Administrator of the National Telecommunications and Information Administration (NTIA).³¹ Both the FCC and the NTIA aim to serve the “best interests of the public,” although the Act does not define this standard.³² The FCC has been given broad discretion in its interpretation of what that standard is in actuality.

The spectrum landscape began to change significantly in the 1980s with the evolution of broadcast radio and television to early mobile phone use. In 1993, the U.S. Congress amended the Communications Act to create Commercial Mobile Radio Services (CMRS) or cellular/wireless services.³³

²⁶ ITU Constitution, Article 1, Nos. 10, 11, and 12.

²⁷ Preamble of the Radio Regulations, Nos. 0.4 and 0.8.

²⁸ Simon Muys, “Can OFCOM achieve the wireless balancing act? A look at ‘harmonized flexibility’ and some practical implications for UK spectrum users” available at: http://www.olswang.com/pdfs/telecoms_nov05.pdf (date accessed: 11 January 2015).

²⁹ ITU Radio Regulations No. 1.169.

³⁰ 47 U.S.C. § 151 *et seq.*

³¹ *Ibid.*

³² *Spectrum Policy for the 21st Century – The President’s Spectrum Policy Initiative: Report 1* (U.S. Dept. of Commerce, June 2004) at 4,9.

³³ Pub.L. No. 103-66, Title VI, 602(b), 107 Stat. 312 (1993) (Omnibus Budget Reconciliation Act of 1993). Unlicensed uses were first included in the FCC’s

In 2003, then-President Bush issued a Memorandum that initiated a Task Force and public meetings to help frame spectrum policy for the 21st Century. The Memorandum announced President Bush's commitment that by 2007, all Americans should have universal, affordable access to broadband (WIFI being the technology most likely to facilitate this).³⁴ Remember, WIFI is an unlicensed use.

The FCC has adopted policies to facilitate the licensing of as many systems as possible with a minimal amount of interference – not requiring an absence of any interference, but allowing *de minimus*. However, its technical rules prohibit harmful interference to stations/users sharing adjacent bandwidth.³⁵ That said, a bright line definition of “harmful interference” has proven elusive, despite policy declarations assigning gravitas to clear delineation of spectrum rights.³⁶ Clarity is present in spectrum scholarship in several contexts: first, as regards clarity or “exactitude” in defining interference,³⁷ and next with regard to clear default operating rights.³⁸

What do those default rights look like? Is there a duty that can be inferred with regard to interference? Must the onus to avoid the interference fall upon the new entrant as opposed to the incumbent? Even when the incumbent, in our example GPS, has chosen to utilize inferior technology (the cheaper unfiltered receivers) despite the social cost inherent in depriving the market of an innovative use of the resource (LightSquared's business model)?

The idea that one user's rights should trump the others does not allow for organic responses to new technologies. These systems affect one another. More troubling is the fact that the license involving newer technology was constrained and ultimately derailed by old, somewhat obsolete equipment. This was rationalized by the old paradigm of interference – that the spillover was unacceptable and fully the responsibility of the new entrant. Further, users are not given enough latitude and flexibility to sort their disputes out privately.

FCC decisions have permitted a waste of resources. Sometimes these decisions have simply favoured one use over another, other times the agency's actions merely lacked a long-term vision. For instance, in 1997 the FCC imposed strict requirements on wireless spectrum contiguous to spectrum bought at auction

management scheme in 1985 when the agency opened up and made available to these uses frequency bands, a precedent which it continues to honor.

³⁴ “Spectrum Policy Initiative Fact Sheet” available at: http://www.ntia.doc.gov/legacy/reports/specpolini/factsheetspecpolini_06242004.htm (date accessed: 19 January 2015).

³⁵ FCC Rules Sec. 15.5 General conditions of an operation.

³⁶ Thomas Hazlett and Sarah Oh, “Exactitude in Defining Rights: Radio Spectrum and the ‘Harmful Interference’ Conundrum” 28 Berkeley Tech L.J. 227 (2013).

³⁷ *Ibid.*

³⁸ J. Pierre DeVries, “Harm Claim Thresholds: Facilitating More Intensive Spectrum Use Through More Explicit Interference Protection Rights” 12 J. Telecomm. & High Tech. L. 55 (2014).

by digital audio radio (Sirius and XM Radio). In the agency's zeal to promote digital radio it imposed constraints so onerous that the wireless spectrum was rendered useless for many years.³⁹ Similarly, M2Z's efforts to create a coast-to-coast free wireless broadband system tanked after existing carriers (incumbents) complained.⁴⁰ The FCC bucked the trend toward protection of unlicensed users (like GPS) in a more recent FCC decision to authorize Progeny, a location and monitoring network that would impact unlicensed users of Part 15 equipment.⁴¹

Tension exists between licensed and unlicensed users. At one time, unlicensed users operated knowing that they were not to incur interference nor could they claim protection from interference.⁴² Licensed users agreed to use the allotted spectrum for a specific device without creating interference for other licensees and were protected from harmful interference.⁴³ As unlicensed uses have gained in reach and popularity, the FCC has shifted its priorities, in keeping with policy, seemingly granting rights that were not previously there.⁴⁴

V. Responses

Clearly, there is great social and consumer value in new, innovative uses of technologies. The challenge in negotiating overlap in systems, and this case frequency use, is in conflict management. In the case of spectrum, border control may not be the most effective answer. In other words, simply policing the borders of allotted spectrum may not be the best use of the FCC's time and talents, particularly when those borders are not clear-cut. A licensee can operate in compliance with its license's parameters and STILL cause problems for a nearby, unlicensed user.

Various responses to this conundrum have surfaced in the past few years. In fact, a flurry of scholarship deals with the LightSquared dilemma.⁴⁵ These range from discussion of clarity in defining "interference" (much less

³⁹ "Opposition of Sirius Satellite Radio, Inc.," In Re: Consolidated Request for Limited Extension of Deadline for Establishing WCS Compliance with Section 27.14 Substantial Service Requirement" WT Docket No. 06-102.

⁴⁰ Kit Eaton, "M2Z's Free, Wireless Nationwide Broadband Plan Killed: Thank the FCC" Fast Company (2 September 2010) available at: <http://www.fastcompany.com/1686542/m2zs-free-wireless-nationwide-broadband-plan-killed-thank-fcc> (date accessed: 15 May 2015).

⁴¹ Mitchell Lazarus, "FCC Authorizes Progeny over Part 15 Objections" (posted on 8 June 2013) available at: <http://www.commlawblog.com/2013/06/articles/unlicensed-operations-and-emer/fcc-authorizes-progeny-over-part-15-objections/> (date accessed: 15 May 2015).

⁴² 47 U.S.C. § 15 (2012)

⁴³ 47 U.S.C. § 301 (2006)

⁴⁴ Gregory Rosston, "Increasing Wireless Value: Technology, Spectrum, and Incentives" 12 J. Telecomm. & High Tech. L. 89, 102 (2014).

⁴⁵ All the articles quoted herein are a good example.

“harmful interference”) to economic models including the sharing of resources and flexibility in allocation and management of interference. Acknowledging the difficulties inherent in clarifying a definition of harmful interference that is predicated upon years of US precedent, the Institute of Electrical and Electronics Engineers- United States of America (IEEE-USA) published a White Paper in 2012 dealing with the problems arising between incumbents and innovators, most often with regard to the licensed and unlicensed dichotomy.⁴⁶ To date, the only express definition of harmful interference is found in ITU Radio Regulations, discussed *supra*, and incorporated into FCC Rules and the NTIA Red Book.⁴⁷ For all that, the ITU actually uses the concept of “tolerable interference” when navigating disputes in interservice spectrum sharing.⁴⁸ There is something intuitive in this response. It may be more pragmatic than pursuit of an ephemeral bright line definition in a technological environment that continually pushes the boundaries of frequency transmission and receiver efficiency.⁴⁹ The idea of thresholds is conceptually related to that of tolerability. Responsibility for interference to both transmitters and receivers would be a shared duty to behave responsibly.⁵⁰ The costs to adjacent users and society at large imposed by systems that cannot tolerate other reasonable systems are unfair. Instead, the affected system ought to step up and be accountable for its role. This could translate into better receiving equipment but it could also mean different settings for the strength of signals received.⁵¹ Harm thresholds would flow from up front statements in a new service’s rules defining the situations when a receiver and/or transmitter would bear the cost of mitigating interference.⁵² DeVries’ tent analogy illustrates the trade

⁴⁶ “Clarifying Harmful Interference Will Facilitate Wireless Innovation: A White Paper by IEEE-USA’s Committee on Communications Policy” IEEE-USA (2012) available at: <http://www.ieeeusa.org/policy/whitepapers/IEEEUSAWP-HarmfulInterference0712.pdf> (date accessed: 15 May 2015).

⁴⁷ The NTIA Red Book refers to the agency’s manual and can be accessed at: <http://www.ntia.doc.gov/page/2011/manual-regulations-and-procedures-federal-radio-frequency-management-redbook> (date accessed: 15 May 2015).

⁴⁸ IEEE White Paper, *supra* note 46 at 8; see also Rec. ITU-R RA.769-2 “Protection criteria for radio astronomical measurements”; “Radar Sharing with Mobile Services in Band 2700-2900 MHz” Presented by ICAO Secretariat at Regional Preparatory Group Meeting for World Radio Communication Conference 2003, Nairobi, Kenya 18-30 April 2002.

⁴⁹ Hazlett, *supra* note 36 at 233. Furthermore, flexible use rights could alleviate the need to increase clarity of rights. DeVries, *supra* note 38 at 60.

⁵⁰ DeVries, *supra* note 38 at 56.

⁵¹ *Ibid.* at 64.

⁵² “Interference Limits Policy: The use of harm claim thresholds to improve the interference tolerance of wireless systems” White Paper by Receivers and Spectrum Working Group, FCC Technological Advisory Council (2013) at 7.

offs between systems in such a harmful thresholds matrix.⁵³ With it, he describes a property line between adjacent properties. One is a tent and the other is presumably a house. The person living in the tent (Bob) is likely more sensitive to noise than his neighbour (Alice). It would be unreasonable for Bob to demand that Alice whisper when she is in her garden. Bob could move indoors (not in his tent...). Or, he could ask visitors to speak loudly or retreat to a further location within his tent. Harm would be reciprocal; hence, both parties would be incentivized to sort things out between themselves and find balance.⁵⁴

The thresholds represent ceilings on interfering signals that must be exceeded before actionable harm could be claimed. The thresholds are not government receiver mandated standards. They are interference limits.⁵⁵ This *ad hoc* approach to flexible use rights has the potential to substantially reduce disputes between transmitters and receivers. FCC rules would be defaults subject to adjustment by operators; when private law would fail, regulators could then get involved.

Another economically driven solution to incompatible uses includes allowing more flexibility in allocation. Licensees could change the nature of transmissions, subject to the interference parameters of licenses (which could be harmful thresholds as described) and perhaps modified through negotiations.⁵⁶

The FCC has successfully employed incentive auctions to free up unused broadcast television spectrum to be repurposed for wireless broadband.⁵⁷ Users can share spectrum in a hierarchical system of primary, secondary, and tertiary users with each level representing different rights, obligations, and expectations.⁵⁸ The point is that models exist to manage the tension between users. And, further, these models do not rely upon a regulatory authority to arbitrarily and inconsistently choose one use over another but, instead, allow the market to bear its opportunity costs. The market is more incentivized to resolve disputes and generate profits.

Hazlett discusses millennial challenges to spectrum use in terms of anti-commons gridlock.⁵⁹ Typically, spectrum is discussed in terms of a commons, with appropriate ITU allocation and regulation working to avoid the tragedy of over-utilization of the resource. However, Hazlett posits that gridlock is resulting from lack of clarity about harmful interference, fragmentation of

⁵³ DeVries, *supra* note 38 at 65.

⁵⁴ Avoiding disturbance to Bob by silencing Alice causes harm to Alice's freedom of expression. Allowing Alice to make noise harms Bob's peace. *Ibid.*

⁵⁵ *Ibid.* at 66; FCC White Paper, *supra* note 52 at 7.

⁵⁶ Rosston, *supra* note 44 at 103.

⁵⁷ "Incentive Auctions: Unleashing spectrum to meet America's demand for mobile broadband" FCC website available at: <https://www.fcc.gov/incentiveauctions> (date accessed: 15 May 2015).

⁵⁸ Rosston, *supra* note 44 at 99.

⁵⁹ Hazlett, *supra* note 36 at 240.

rights (and, this author proposes, uses), and restrictions imposed by regulatory authorities with less of a stake in successful resource management.⁶⁰ This gridlock is also a tragedy, a tragedy of the anti-commons, where the resource is not over-utilized but under-utilized because of a lack of access through authorized use. This is one legal ramification of disruptive technology.

VI. Other Applications

Is it possible to extrapolate the problems faced by LightSquared to other applications? Kymeta is another company with vision. In 2013, the company successfully demonstrated bi-directional high-speed Internet connectivity with a Ka broadband satellite using its meta-materials antenna.⁶¹ The antenna uses artificial materials that are engineered to manipulate electromagnetic radiation, resulting in very targeted electronic beam-steering, the technology used for cloaking.⁶² The precision can be achieved using significantly smaller hardware than traditional parabolic disc antennae and/or mechanical terminals or phased array antennae and with the ability to connect literally anywhere in the world.⁶³ However, problems could arise. How will Kymeta's disruptive innovation perform in the presence of interfering radio signals that might be able to externally modify the beam direction? Or could the beam create interference for a neighbour use of spectrum, echoing problems akin to LightSquared, perhaps? Allowing either of those scenarios to deprive industry of Kymeta's advances would be unacceptable. The tragedy of the anti-commons should be avoided with as much zeal as the tragedy of the commons.⁶⁴

VII. Recommendations

There are a great many lessons to be learned from the spectrum challenges outlined, albeit briefly, in this comment. Discussion is underway at all levels, from ITU World Radio Communications Conferences to FCC Working Groups to blogs. Underpinning the discourse is the awareness that new technologies and innovations could be held hostage by obsolete ideas.

⁶⁰ *Ibid.*

⁶¹ Ariel Bleicher, "Kymeta Demos First Ever Satellite Link with Metamaterials Antenna" *IEEE Spectrum* (1 May 2013) available at: <http://spectrum.ieee.org/tech-talk/telecom/wireless/kymeta-demos-first-ever-satellite-link-with-metamaterials-antenna> (date accessed: 15 May 2015).

⁶² Katie Palmer, "Intellectual Ventures Invents Beam-Steering Metamaterials Antenna" *IEEE Spectrum* (30 November 2011) available at: <http://spectrum.ieee.org/telecom/wireless/intellectual-ventures-invents-beamsteering-metamaterials-antenna/0> (date accessed: 15 May 2015). Intellectual Ventures is Kymeta's predecessor.

⁶³ Kymeta website, available at: <http://www.kymetacorp.com/technology/> (date accessed: 15 May 2015).

⁶⁴ Hardin, Garrett, "Tragedy of the Commons" *162 Science* 1243 (1968).

Archaic thinking takes many forms, from bright line rules that are not compatible with reality to either a lack of or over regulation, resulting in under utilization of resources.

However, acknowledgement of the duties and responsibilities shared by both licensed and unlicensed users, by transmitters and receivers, by incumbents and new entrants, is the key to an approach that allows technologies to evolve. The regulatory system needs to allow for this flexibility.

There will come a time when other activities in less traditional space-related fora encounter the possibility of an anti-commons because of old ideas bucking up against new technologies with business models that are feasible but for the lack of responsive regulation. LightSquared is a cautionary tale. We would be wise to heed its lessons.