

Report
Enforcement Working Group
CSMAC
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Critical Assumptions/Critical Questions

The Enforcement Working Group has identified a series of questions that it believes should be answered in its enforcement study effort. The questions below are based on a number of operational assumptions, specifically:

Critical Assumptions

- Spectrum use is based on a generic Spectrum Access System (SAS) that employs dynamic spectrum sharing based upon the geo-location/database approach applicable to geographic/co-channel and/or adjacent-band sharing;
- Sharing is between a commercial system and a federal-government system; and
- Access points associated with the commercial system are under the control of a Network Operating System (NOS) which has the ability to remotely change the power of the individual access points, to change the antenna radiation patterns (e.g., using beam steering), to turn the access point off entirely, to change channels within the band, and to perform certain other diagnostic and interference mitigation actions.

Critical Questions

1. What proof would a potential victim system have to supply in making an interference complaint? How would (harmful?) interference be defined and who would specify the measurement process? Could the measurement and reporting mechanism be automated by the Spectrum Access System (SAS)? Would the victim be expected to supply information on the signal causing the interference -- i.e., the equivalent of call letters if available or the direction or location of the interference source? How would the cost of detecting and mitigating the interference be distributed?
2. What if very poor receiver performance was the cause of the interference rather than a transmitter issue? Is a minimum receiver performance specification assumed? Are harm claim thresholds as proposed by the FCC's Technical Advisory Committee (TAC) necessary to protect the rights of transmitting parties?
3. On what grounds could the commercial system causing interference refuse to take action? What would happen if that entity refused to respond and mitigate the interference? What due process rights would a commercial entity have when faced with a demand by a federal government agency to mitigate the interference? Who decides whether the mitigation is adequate and resolves disputes over whether it is or not? Is a third-party dispute resolution authority necessary to resolve government-commercial disputes? What process is followed if the system operated by the federal government agency is causing unexpected (harmful) interference? Who decides whether the interference has, in fact, been adequately mitigated?
4. Is it assumed that there will be some type of contractual relationship or MOU between the commercial operator and the government agency? Would the agreement spell out the

processes and responsibilities of the parties involved? How would the terms of such a contract or MOU be enforced when the federal government is on one side of the agreement? What type(s) of sharing arrangements would require a bilateral agreement, as opposed to general rules-based terms of use?

5. What would be the FCC Enforcement Bureau's (EB) scope of authority? For example, if the interference to the government systems persists despite mitigation efforts, could the government system operator complain directly to the FCC? What if the interference is caused by another source, not the system under control of the NOS operator? What body would be tasked with investigating issues of third-party interference? If the interference results from noise or another licensed user, operating within their license terms, is there any recourse for the complainant? Apparently NTIA has no enforcement authority but, even if that remains the case, what resources will NTIA and/or individual agencies devote to interference resolution and enforcement.
6. Related to Q. 5, how would the process outlined interface with the normal EB interference resolution and enforcement activities? What provisions would be made for emergency shut-downs in severe situations and who would make the decision as to whether a particular incident is severe enough to trigger an emergency response? Would the emergency shut-down process vary depending upon the nature of the agencies' missions? Can these decisions be made rapidly in an automated fashion by the Spectrum Access System (SAS)? Should transmitting devices be required to integrate a hardware lock to ensure shutdown in emergency situations?

NTIA Case Study

Sharing radio spectrum raises many new concerns when it comes to potential interference and the enforcement mechanisms that might be needed to resolve interference.

Specific Examples

1. In portions of the 5 GHz range, the FCC has authorized unlicensed WiFi using dynamic frequency selection to protect radars operated by the government on a primary basis. While DFS may work as designed, many WiFi operators are modifying the equipment in such a way that the equipment does not comply and causes interference into FAA wind shear radars. While the FCC has taken steps to apprehend the offenders, after several years, they continue to pop-up and disrupt critical safety operations. We continue to play Whac-a-mole. The problem seems to be that the unlicensed devices are widely distributed, the users unknown, the locations hard to identify, and the equipment easily altered.

Resolution – How should we deal with a large number of unlicensed operations, causing significant interference, when the operators seem willing and easily able to alter the characteristics outside the regulations?

2. At 1695-1710 MHz, we are heading toward a reallocation to allow licensed cell operations in the same band with weather satellite receive earth stations. While we could use exclusion zones around the earth stations, as a simple protection mechanism, the service providers think they can operate compatibly inside such zones. The techniques they may use would be implemented site by site and would vary by site. Furthermore, the potential for interference may result from an aggregate of signals, not a single emitter. The problem is how you determine when aggregate signals surpass accepted levels. Given the variability of approaches used by each service provider site by site, the satellite earth station representatives do not want to accept a paper calculation. They have suggested a need for spectrum monitors to measure the level of potentially interfering signals. Is this likely to become a requirement in other shared bands? If interference results from an aggregate and possibly and aggregate over multiple carriers, how would a fix be enforced?

Resolution – What steps/procedures can be taken to ensure that aggregate signals levels do not exceed minimum levels so as to mitigate interference to incumbent operations? Should solutions include the installation of monitoring stations by the incumbent or the new entrant and/or specific sharing arrangements that require interference identification and resolution processes? Further, in the event these approaches fail, what enforcement processes should be instituted **and by whom?**

Recommendations¹ (Preliminary)

1. Mutual efforts between Federal operators and commercial entities designed to identify, mitigate, and remedy instances of interference resulting from spectrum sharing shall be determined prior to the sharing of spectrum. Necessary processes, protocols, terms and conditions may be formalized in any number of approaches including, but not limited to Memorandums of Understanding/Agreement between the participating parties or, rule based sharing protocols prior to the sharing of spectrum. These binding contracts and/or rule provisions may also define the processes and assets that would be dedicated to interference mitigation procedures as well as enforcement activities in the event of disputes or the appearance of unapproved device operations. Sharing terms and conditions may include methods on how interference mitigation and enforcement activities shall be funded including potentially new sources of financial support; and specific equipment operational requirements managed through the FCC's type-acceptance processes.

Outstanding/Unresolved Issues - In the case of a disagreement over the terms or implementation of an MOU, how is the dispute resolved? How does the situation change, if at all, when one or more of the parties to the MOU is a government agency? What precedents are there for private-government MOUs in the spectrum space? Where should rule based protocols versus MOUs versus contracts be used? What are the comparative advantages and disadvantages of each?

2. A "Process Flow Chart" should be developed presenting the myriad of procedures that are recommended to be followed by and among Federal Agencies and commercial entities regarding interference identification, mitigation, resolution approaches and enforcement activities.

Outstanding/Unresolved Issues – Should the Process Flow Chart be band specific, and/or should the chart's application be ad hoc in nature, that is, to assist the Enforcement Working Group in developing and explaining recommended approaches to interference resolution and enforcement in the various bands at issue.

3. A definition of what constitutes "harmful" interference must be identified to/from Federal agencies and commercial entities in instances of either licensed or unlicensed spectrum sharing.

Outstanding/Unresolved Issues – Definitions need to be band and use specific. Further, there are strong opinions that a "Harms Claim Threshold" is the optimum approach. For example, the de facto MOU between AT&T and Sirius that became the updated WCS/SDARS rules constitutes a precedent for the harm claim threshold approach e.g. "received power not to exceed -40 dBm over more than 1% of the drive route."

¹ These recommendations have not been finalized nor officially approved by the Enforcement WG at present.

4. NTIA and the FCC should explore regulatory regimes that fully fund appropriate enforcement activities, i.e., personnel, equipment, etc. as a necessary and integral part of spectrum management. Government should explore whether funding could be provided through equipment approval fees, regulatory fees, or through auction revenues. In today's spectrum environment, enforcement must be considered as integral to effective spectrum management as other government funded functions such as international coordination and service rule development.

Outstanding/Unresolved Issues – Should the possibility of direct Congressional appropriations (and authorizations, if needed) beyond what is appropriated today based on fees and auction revenues be dismissed? Should additional research funding in the area be provided as well, perhaps through NSF, DARPA, NTIA or one of the individual government user agencies?

5. Amendments to the Communication Act that would support enforcement efforts, specifically holding responsible those persons and/or entities that enable non-compliance with FCC Rules & Regulations, should be drafted and introduced.

Outstanding/Unresolved Issues – More specifics are absolutely necessary, and this recommendation does NOT imply that spectrum sharing should be delayed until such time as Congress develops and passes proposed legislation.

Enforcement in Spectrum Sharing Proceedings (Draft)

Question Presented

To what extent was the issue of enforcement considered in the 3.5 GHz, 1695-1710 MHz, and TV White Space spectrum sharing proceedings? Regarding those bands, has progress been made toward resolving enforcement issues?

Brief Answer/Introduction

In the 3.5 GHz, 1695-1710 MHz, and TV White Space proceedings, enforcement has received much less attention than the processes and regulations that are necessary for dynamic spectrum access (DSA) systems. Notices of proposed rulemaking and comments in response acknowledge that enforcement is necessary for spectrum sharing regimes to be successful. However, the policies, procedures, and authority that must be established to protect the rights of shared spectrum license holders and encourage investment in shared bands have only been lightly considered. This memo will briefly summarize the President's Council of Advisors on Science and Technology (PCAST) report and Commerce Spectrum Management Advisory Committee (CSMAC) report that provide frameworks for spectrum sharing dispute resolution and enforcement. Then, it will briefly discuss enforcement considerations in the 3.5GHz, 1695-1710 MHz, and TV White Space proceedings.

PCAST and CSMAC Reports

In July 2012, the President's Council of Advisors on Science and Technology released a report that, amongst other things, highlighted the potential of government-held spectrum to spur economic growth ("PCAST report").² Appendix E of the PCAST report pertains to issues of enforcement in a DSA framework; it provides a conflict resolution framework for resolving spectrum sharing disputes.³ The report recognizes that a robust system is necessary to resolve spectrum sharing disputes. It concludes that disputes should be considered normal and resolvable through this framework.⁴

The PCAST report provides three goals for spectrum sharing enforcement.⁵ First, the process must be dependable, with jurisdictional responsibilities for resolving disputes that are clear and unambiguous. Second, enforcement must be timely; parties need a predictable schedule for resolving disputes. This requirement is especially critical because of the business risks inherent in a sharing model. Third, the process must be efficient and the cost to resolve disputes must be minimized. The report contends it is better to resolve disputes with low cost and a short time frame than the opposite, even if higher costs and longer time frames may lead to better resolution in some cases.

² Report to the President, Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth, President's Council of Advisors on Science and Technology (July 2012)
http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf.

³ Id. at 123.

⁴ Id.

⁵ Id.

The report advocates for a single authority that is given sole responsibility for adjudicating and enforcing spectrum usage rights.⁶ A single authority is necessary because spectrum management is spread amongst a diverse number of authorities. In order to facilitate dynamic alteration of rights through market-based sharing, a single authority should resolve claims based on technical merits, not based on license terms. Because of the swift evolution of spectrum sharing technology and capabilities, the authority should have a deep bench of legal and economic expertise.⁷ Finally, the report suggests that the White House Spectrum Management Team could serve as a federal adjudicator of spectrum sharing disputes.⁸ The PCAST report provides a starting point for crafting spectrum sharing enforcement policies.

In its final report, the Interference and Dynamic Spectrum Access Subcommittee of the CSMAC also provided recommendations for enforcement and resolution of interference complaints in a DSA system, including reporting mechanisms and monitoring techniques.⁹ The subcommittee outlined a process for ordering an offending transmitter to cease transmission. First, cognitive radio would be used to sense the surrounding spectrum environment and report cases of interference violations.¹⁰ Then, the FCC would use a shot clock approach to resolve interference complaints.¹¹ Notably, the subcommittee advocated this approach for both private and government incumbents. The report also advocates for streamlined reporting mechanisms that allow for quick reporting of localized interference incidents.

In addition to this ex post enforcement procedure, the report said that devices must be tested prior to deployment for ability to share without causing harmful interference.¹² After they are sold to the public, devices should be monitored to ensure real-world compliance.¹³ The committee believed that the FCC and NTIA should be responsible for proactively addressing interference concerns, rather than putting the onus entirely on the complainant.¹⁴ This monitoring by the FCC and NTIA would require a substantially larger enforcement budget. The report notes that monitoring need not be “always on”; geographic areas should be tested and monitoring should focus on trouble spots with more frequent non-compliance.¹⁵ Finally, penalties for interference should be increased to protect incumbents and deter the use of interference as a competitive advantage in bands with sharing.¹⁶ The report concludes that these steps would facilitate sharing while protecting the rights of each party in the band. Without a careful enforcement framework, harmful interference that could stunt investment in shared bands.

⁶ Id. at 124.

⁷ Id.

⁸ Id.

⁹ See Final Report, Interference and Dynamic Spectrum Access Subcommittee, Commerce Spectrum Management Advisory Committee, NTIA (Nov. 8, 2010) http://www.ntia.doc.gov/files/ntia/publications/csmac_interferencecommitteereport_0102011.pdf (CSMAC 2010).

¹⁰ Id. at 75.

¹¹ Id.

¹² Id. at 76.

¹³ Id.

¹⁴ Id. at 73.

¹⁵ Id. at 74

¹⁶ Id.

Although the PCAST and CSMAC reports provide good starting points for enforcement policies, the proceedings that are crafting DSA policies have not considered enforcement issues as thoroughly as most other issues surrounding DSA implementation. With this framework in mind, this memo will now consider the extent to which enforcement has been considered in three frequency bands.

3.5 GHz Proceeding

In December 2012, the FCC released a Notice of Proposed Rulemaking and Order (“3.5 GHz NPRM”) for the 3550-3650 MHz band.¹⁷ The NPRM suggested a tiered sharing approach wherein General Authorized Access (GAA) users register their use in a spectrum access system (SAS) and are granted permission to operate.¹⁸ The GAA use is conditioned upon non-interference with two higher-tiered categories of use, the Incumbent Access and Priority Access users.

In the 3.5 GHz NPRM, enforcement is mentioned only five times in the 65 page document. The NPRM seeks comment on technical challenges and possible solutions for enforcement challenges, such as how to create safeguards and tamper-resistant devices.¹⁹ It also seeks comment on how to enforce incumbent protections in Incumbent Use Zones and how to use the SAS to enforce priority user’s rights in specific geographic locations.²⁰ Finally, it mentions that GAA users must register their use in the SAS and comply with all “enforcement rules to ensure that GAA users avoid causing harmful interference to Incumbent Access and Priority Access users and always accept harmful interference from such users.”²¹ Although the 3.5 GHz NPRM requested comment on enforcement, the responses were limited.

Most of the comments in response to the NPRM that mention enforcement do so only in general terms. Many commenters simply stated that they believe a SAS can adequately handle enforcement if it is properly designed.²² For example, Spectrum Bridge advocated that the SAS should be used “to carry out certain enforcement requirements, such as blacklisting specific devices or device types, establishing more restrictive use per device type or user and provisioning more (or less) restrictive policies by location, frequency and time.”²³ Spectrum Bridge also suggested that all monitoring and enforcement should remain at the FCC.²⁴

However, some commenters provided more specific recommendations. Pierre de Vries proposed using harm claim thresholds to provide more intense, opportunistic use of shared spectrum while protecting incumbent users.²⁵ He also discussed enforcement challenges that could arise from an aggregation problem, because many GAA devices transmitting simultaneously

¹⁷ Notice of Proposed Rulemaking and Order, GN Docket No. 12-345 (Dec. 12, 2012).

¹⁸ Id. ¶¶ 7-10.

¹⁹ Id. ¶ 100.

²⁰ Id. ¶¶ 101, 125.

²¹ Id. ¶¶ 10, 65.

²² See, e.g., Comments of New America Foundation and Public Knowledge, Docket 12-345, Dec. 5, 2013, at 17; Comments of WISPA, Docket 12-345, Dec. 5, 2013, at 18; Comments of T-Mobile, Docket 12-345, Dec. 5, 2013 at 6

²³ Comments of Spectrum Bridge, Docket 12-345, Dec. 20, 2013.

²⁴ Id.

²⁵ Comments of Pierre de Vries, Docket 12-345, Feb. 20, 2013.

could create issues for noise-limited primary devices.²⁶ Google's sole mention of enforcement was the suggestion that devices should integrate a hardware lock, "to restrict device operations to the parameters approved by the SAS."²⁷ It believes that this measure would make DSA devices "highly tamper-proof."²⁸

T-Mobile raised a concern that, while the three-tier approach would give the Priority and Incumbent Access tiers sufficient rights enforceability, the GAA users would have no such recourse to enforce their rights. Therefore, GAA-tier use would be under-incentivized and the spectrum utilization would remain sub-optimal.²⁹ Although T-Mobile raised this enforcement concern, it did not propose solutions for the problem. The Satellite Industry Association stated that the interference prevention measures need to be enforceable from a practical perspective.³⁰ For example, rules limiting the operations of local networks to indoor use may be practically unenforceable. They also raised concerns regarding out-of-band interference limit enforcement.³¹

These concerns and suggestions were the only comments about enforcement made in response to the 3.5 GHz NPRM. Even where enforcement is mentioned, there are very few solutions proposed for the myriad challenges. This trend continued in the most recent workshop on 3.5 GHz sharing.

In January 2014, the FCC's Wireless Telecommunications Bureau (WTB) and Office of Engineering and Technology (OET) hosted a workshop on the spectrum access system (SAS) proposed in the 3.5 GHz NPRM.³² Of the 25 presenters, only six mentioned enforcement challenges in their presentations. Most of the comments focused on the importance of the SAS for enforcement and dispute resolution. For instance, Lucent simply recommended that a monitoring and enforcement framework should be implemented to manage all the SAS functions. Similarly, BAE proposed using formal policy-based management techniques when architecting the SAS. It emphasized the importance of understanding where the management technique policies are generated, applied, and enforced.

Federated Wireless and Intel provided perspectives on how to use the SAS to meet enforcement goals. The former advocated for a three-tiered SAS with a secure core, a regional layer, and a lower layer. These three tiers would enforce spectrum usage rights in concert. The secure core would aggregate and analyze channel state information, the regional control centers would be operated by commercial entities for the benefit of public spectrum use, and the lower layer of nodes would authorize use and clear spectrum in response to threats or on command of the secure core system. T-Mobile also recognized that enforcement will be a challenge and suggested simplified system architecture. This framework would leverage existing technologies "as is," clearly establish boundaries between the SAS and the operator network, and create manageable information exchange. It also highlighted that there must be clear interference

²⁶ Comments of Pierre de Vries, Docket 12-345, Feb. 20, 2013.

²⁷ Comments of Google, Docket 12-345, Feb. 20, 2013, at 19.

²⁸ Comments of Google, Docket 12-345, Feb. 20, 2013, at 19.

²⁹ Comments of T-Mobile, Docket 12-345, Feb 20, 2012, at 6.

³⁰ Comments of Satellite Industry Association, Docket 12-345, Dec. 5, 2013, at 6-7.

³¹ Comments of Satellite Industry Association, Docket 12-345, Dec. 5, 2013, at 6-7.

³² All of the presentations are available on the 3.5 GHz Spectrum Access System Workshop page at <http://www.fcc.gov/events/35-ghz-spectrum-access-system-workshop>.

mechanisms. Intel differentiated between licensed spectrum enforcement, where the SAS sends a message to the coordinating entity to locate and extinguish interfering transmissions, and unlicensed spectrum enforcement, where the SAS ends all transmissions in the area affected by interference until the issue is resolved.

Amongst the commenters, Virginia Tech provided the most comprehensive and detailed discussion of enforcement issues. It highlighted the critical importance of security and enforcement when dealing with a common resource such as spectrum. Virginia Tech discussed the many threats to the privacy of primary users, secondary users, and the database access protocol. It also provided examples of ex ante (preventative) and ex post (punitive) enforcement measures. These included schemes for uniquely identifying, localizing, and punishing non-compliant transmitters or transmissions. Although some commenters discussed enforcement and conflict resolution issues, most failed to mention the challenges presented by enforcing sharing rules.

1695-1710 MHz Proceeding

The 1695-1710 MHz (“1700 MHz band”) proceeding largely mirrored that of the 3.5 GHz proceeding regarding spectrum sharing enforcement. Although some commenters considered enforcement challenges, the discussion has been focused on other issues. First, this memo will provide brief background on sharing in the 1700 MHz band.

The National Telecommunications and Information Administration (NTIA) evaluated the possibility of spectrum sharing between federal and commercial users in the 1700 MHz band in an October 2010 report (“Fast Track report”).³³ In the Fast Track report, the NTIA analyzed the possibility of reallocating spectrum currently used by Federal agencies to commercial broadband use. It concluded that 115 MHz of spectrum, including the 1700 MHz band, should be made available for commercial broadband either as a sole use or through spectrum sharing.³⁴ For the 1700 MHz band, the Fast Track report recommended that exclusion zones be implemented around sensitive meteorological-satellite stations that currently rely on transmissions utilizing the band. Outside these exclusion zones, commercial broadband devices would be allowed to operate.

In its January 2013 report (“WG-1 report”), the CSMAC’s Working Group 1 (WG-1) built upon the groundwork laid by the Fast Track report. WG-1 provided recommendations on how to successfully allocate the 1700 MHz band “for commercial services while protecting Federal meteorological earth stations from harmful interference.”³⁵ However, rather than the highly-restrictive protection zones that NTIA proposed, WG-1 recommended Protection Zones that allow limited, secondary commercial use.³⁶ Using more realistic models of LTE technical parameters,

³³ An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, and 4200-4220 MHz, 4380-4400 MHz Bands, U.S. Department of Commerce

³⁴ Id. at iv

³⁵ Final Report, Working Group 1 – 1695-1710 MHz Meteorological-Satellite, Commerce Spectrum Management Advisory Committee (Jan. 22, 2013)

³⁶ Id. at 2

WG-1 was able to significantly reduce the commercially-restricted zones around Meteorological Satellite receivers.³⁷

The WG-1 report proposed that the NTIA and FCC create a coordination framework for spectrum sharing.³⁸ Regarding enforcement, it recommended “procedures for implementing ongoing real-time monitoring to ensure [interference limits] are not being exceeded and that commercial operations can be adjusted immediately if they are.”³⁹ The report calls for enforcement mechanisms that are clearly defined and codified in regulations.⁴⁰ Furthermore, it “recognizes that effective monitoring and enforcement mechanisms are critical to sharing” in the 1700 MHz band.⁴¹ Commercial operators should be expected to conduct 24-7 surveillance to detect and eliminate harmful interference. The report highlights that a “mechanism must be established” to protect primary users from commercial interference, but does not identify how the mechanism would operate.⁴² It mentions that, upon detection of harmful interference, “commercial wireless licensees [must] cease operations in the band, in the area of concern, until interference sources are identified and resolved,” but also does not identify how this would be enforced.⁴³ Although WG-1 highlighted the importance of enforcement, it did not propose a detailed enforcement framework in the WG-1 report.

The July 2013 NPRM that called for comments on sharing in the 1700 MHz band dedicated one paragraph in the 102 page document to issues of enforcement.⁴⁴ The section asked significant questions and referenced the WG-1 report:

The WG1 Final Report states that clear enforcement procedures must be established in order to protect Federal operations within the Protection Zones. We seek comment on ways to deter and terminate commercial operations from causing harmful interference to Federal operations through violations of the rules or of a coordination agreement. How should commercial operators be notified to cease operations in such a situation? What can or should be done in the event that there is a dispute between the parties as to the actual source of interference? Do our existing enforcement procedures provide adequate remedies or do the special circumstances of this band require additional enforcement mechanisms? What remedies, above and beyond notice to stop operations, are appropriate in such circumstances? Would fines and/or loss of license be appropriate in this case? Commenters are encouraged to propose adequate enforcement mechanisms that will ensure that incumbent Federal operations do not suffer harmful interference.

However, of the 143 records in response to the NPRM, only eight commenters mentioned enforcement.

³⁷ Id.

³⁸ Id.

³⁹ Id.

⁴⁰ Id.

⁴¹ Id.

⁴² Id.

⁴³ Id.

⁴⁴ Notice of Proposed Rulemaking and Order on Reconsideration, GN Docket No. 13-185 (Jul. 23, 2013) ¶ 70.

The comment that most thoroughly considered enforcement issues in the 1700 MHz band was submitted by Raytheon.⁴⁵ It advocated for a robust FCC enforcement framework⁴⁶ and concluded that the WG-1 report did not provide sufficient analysis of enforcement and interference resolution.⁴⁷ Raytheon believed that federal incumbent users should be entitled to interference-free operation both inside and outside the Protection Zone. This would be accomplished by putting the sole responsibility to demonstrate interfering-free transmission on the commercial licensee.⁴⁸ It advocated for significant enforcement fines and forfeitures to deter violations, up to and including loss of license.⁴⁹ Raytheon also called for licensees to monitor the interference landscape at all times so that, when harmful interference is experienced, the FCC will have a “record of network operation evidence...to aid enforcement.”⁵⁰ The comment provides examples of areas where it might be in a licensee’s interest to violate spectrum sharing rules, such as “exceeding IPC limits, failing to deploy and maintain monitoring systems, operating in Protection Zones without coordination, or expanding operations beyond what has been previously coordinated.”⁵¹ In its reply comment, Raytheon highlighted the general lack of “detailed discussions regarding coordination, testing, interference resolution, and enforcement” by commenters.⁵² Overall, Raytheon presented a uniquely-thorough view of the need for enforcement in the 1700 MHz sharing framework.

The Aerospace Industries Association also mentioned the importance of considering enforcement in spectrum sharing arrangements.⁵³ The AIA was concerned with the details of implementation of spectrum sharing between federal users and wireless broadband.⁵⁴ It asked whether there will be “prompt and meaningful enforcement by the FCC if commercial broadband operations exceed protection levels or cause harmful interference.”⁵⁵ Furthermore, it questioned whether there will be an efficient interference identification resolution process for disputes arising both inside and outside the protection zones.⁵⁶ Although it did so in less depth than Raytheon, the AIA stressed the importance of enforcement policies in making spectrum sharing a success.

Most comments that mentioned enforcement did so only in passing. In its reply, T-Mobile’s sole mention of enforcement said that a framework needs “clear and consistent coordination processes and enforcement mechanisms, as well as a testing program to demonstrate the viability and effectiveness of the proposed protection and mitigation methods.”⁵⁷

⁴⁵ Comments of Raytheon Company, GN Docket 13-185 (Sep. 18, 2013).

⁴⁶ Id. at 36

⁴⁷ Id. at iv

⁴⁸ Id. at v

⁴⁹ Id. at v, 15.

⁵⁰ Id. at 37

⁵¹ Id.

⁵² Comments of Raytheon Company, GN Docket 13-185, 2 (Oct. 28, 2013).

⁵³ See Letter to Acting Chairwoman Clyburn, Aerospace Industries Association, GN Docket 13-185 (Sep. 18, 2013).

⁵⁴ Id. at 2

⁵⁵ Id. at 3.

⁵⁶ Id.

⁵⁷ Comments of T-Mobile USA, Inc., GN Docket 13-185, 9 (Sep. 18, 2013).

Verizon simply called for “appropriate enforcement action, including forfeitures.”⁵⁸ The Telecommunications Industry Association advocated for the “development of robust coordination and enforcement mechanisms at a technical level that can address issues that arise from the shared use of bands.”⁵⁹ Ericsson contends that the success of “the sharing model has not been tested and will rely on the sharing parameters...and enforcement mechanisms associated with specific shared spectrum bands.”⁶⁰ Beyond these calls to action, most responses to the 1700 MHz NPRM did not mention enforcement or propose and solutions for dispute resolution.

TV White Space

The TV White Space (“TVWS”) proceeding considered how to permit wireless broadband transmission in unused TV bands without causing harmful interference for the primary users. In its 2004 NPRM, the FCC requested comment on “proposals for ensuring that harmful interference is not caused by the operation of [TVWS devices] and the enforcement of the rules we are proposing for unlicensed operation on vacant channels.”⁶¹ The NPRM also requested comment on “other possible enforcement mechanisms that might be appropriate and effective.”⁶²

In the TVWS First Report and Order, enforcement was only mentioned once, in regards to exclusion zones: “what would be the appropriate size of the zone and how could it be enforced?”⁶³ Likewise, the Second Report and Order only mentions enforcement once, when considering distance restrictions for TVWS operation near Mexican and Canadian borders.⁶⁴ The Third Memorandum Opinion and Order also only mentions enforcement once, in a footnote.⁶⁵ Rather than considering ex post enforcement options, the proceeding focused on methods to prevent harmful interference. These included a certification process for TV band devices (TVBD), which require approval by the FCC through independent testing. Enforcement is not a primary concern of the TVWS NPRM and orders.

Despite the lean mention of enforcement in the TVWS proceeding, many commenters highlighted the issue. Enforcement is mentioned in 59 comments, 25 reply comments, and 77 notices of ex parte.⁶⁶ Although it is beyond the scope of this memo to provide a detailed summary of these comments, some commenters went into considerable detail regarding enforcement procedures. Enforcement seems to have been more thoroughly considered by commenters in the TVWS proceeding than in the 3.5 GHz or 1700 MHz proceedings.

⁵⁸ Comments of Verizon Wireless, GN Docket 13-185, 21 (Sep. 18, 2013).

⁵⁹ Comments of the Telecommunications Industry Association, GN Docket 13-185, 10 (Sep. 18, 2013).

⁶⁰ Comments of Ericsson, GN Docket 13-185, 5 (Sep. 18, 2013).

⁶¹ Notice of Proposed Rulemaking, ET Docket No. 04-186 (May 25, 2004) ¶ 41.

⁶² Id.

⁶³ First Report and Order and Further Notice of Proposed Rulemaking, ET Docket No. 04-186 (Oct. 12, 2006) ¶ 56.

⁶⁴ Second Report and Order and Memorandum Opinion and Order, ET Docket No. 04-186 (Nov. 4, 2008) ¶ 265.

⁶⁵ Third Memorandum Opinion and Order, ET Docket No. 04-186 (Apr. 4, 2012) FN 53.

⁶⁶ From ECFS search on FCC.gov (<http://apps.fcc.gov/ecfs/>).

Conclusion

Enforcement has not been a primary concern in most of the NPRMs, orders, and comments in the 3.5 GHz, 1700 MHz, and TV White Space proceedings. Although some scholars have considered the issue of enforcement in detail, this conversation does not yet seem to have been absorbed into the official proceedings.⁶⁷

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⁶⁷ See, e.g., Mohammed Altamimi, Martin Weiss, & Mark McHenry, *Enforcement and Spectrum Sharing: Case Studies of Federal-Commercial Sharing*, available at http://d-scholarship.pitt.edu/19666/1/TPRC_2013_Final.pdf.