

**Before the
Federal Communications Commission
Washington, DC 20554**

In the Matter of:)	
)	
Unlicensed Use of the 6 GHz Band)	ET Docket No. 18-295
)	
Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz)	GN Docket No. 17-183
)	
)	
)	

**COMMENTS OF
THE NATIONAL PUBLIC SAFETY TELECOMMUNICATIONS COUNCIL**

The National Public Safety Telecommunications Council (NPSTC) submits these comments in response to the Notice of Proposed Rulemaking in the above captioned proceeding.¹ The Public Notice seeks comment on proposed rules to implement automatic spectrum sharing by unlicensed devices in the 6 GHz band used for critical fixed microwave links and other services. In these comments, NPSTC addresses some overall concerns about the proposal and provides specific recommendations to help protect critical fixed links should the Commission implement automatic spectrum sharing by unlicensed devices in the band.

¹ *Notice of Proposed Rulemaking*, ET Docket No. 18-295 and GN Docket No. 17-183, released October 24, 2018.

The National Public Safety Telecommunications Council

The National Public Safety Telecommunications Council is a federation of public safety organizations whose mission is to improve public safety communications and interoperability through collaborative leadership. NPSTC pursues the role of being a resource and providing advocacy for public safety organizations in the United States on matters relating to public safety telecommunications. NPSTC has promoted implementation of the Public Safety Wireless Advisory Committee (PSWAC) and the 700 MHz Public Safety National Coordination Committee (NCC) recommendations. NPSTC explores technologies and public policy involving public safety telecommunications, analyzes the ramifications of particular issues and submits comments to governmental bodies with the objective of furthering public safety telecommunications worldwide. NPSTC serves as a standing forum for the exchange of ideas and information for effective public safety telecommunications.

The following 16 organizations serve on NPSTC's Governing Board:²

- American Association of State Highway and Transportation Officials
- American Radio Relay League
- Association of Fish and Wildlife Agencies
- Association of Public-Safety Communications Officials-International
- Forestry Conservation Communications Association
- International Association of Chiefs of Police
- International Association of Emergency Managers
- International Association of Fire Chiefs
- International Municipal Signal Association
- National Association of State Chief Information Officers
- National Association of State Emergency Medical Services Officials
- National Association of State Foresters
- National Association of State Technology Directors
- National Council of Statewide Interoperability Coordinators
- National Emergency Number Association
- National Sheriffs' Association

Several federal agencies are liaison members of NPSTC. These include the Department of

² These comments represent the views of the NPSTC Governing Board member organizations.

Homeland Security (the Federal Emergency Management Agency, the Emergency Communications Division, the Office for Interoperability and Compatibility, and the SAFECOM Program); Department of Commerce (National Telecommunications and Information Administration); Department of the Interior; and the Department of Justice (National Institute of Justice, Communications Technology Program). Also, Public Safety Europe is a liaison member. NPSTC has relationships with associate members: The Canadian Interoperability Technology Interest Group (CITIG) and the Utilities Technology Council (UTC), and affiliate members: The Alliance for Telecommunications Industry Solutions (ATIS), Open Mobile Alliance (OMA), Telecommunications Industry Association (TIA), TETRA Critical Communications Association (TCCA), and Project 25 Technology Interest Group (PTIG).

Introduction

Dynamic or automated spectrum sharing between dissimilar services has been a gleam in the Commissions eye for 15 years or more. While theory, studies, simulations and experimental type trials exist, evidence that actual dynamic spectrum sharing works well in the real world and fully protects authorized users in the spectrum is minimal. Despite the best intentions of the Commission, the history of dynamic spectrum sharing to date does not engender unbridled confidence in the approach.

On May 25, 2004, the Commission released a Notice of Proposed Rulemaking proposing to allow unlicensed devices in spectrum allocated to broadcast television through automated spectrum sharing, i.e., the TV whitespaces NPRM. Subsequent decisions through the years established TV whitespace rules and approved various companies to be TV whitespace database providers. Even with a lineage of strong political interest and a variety of associated proposals and decisions, any evidence that such sharing works well in actual practice is minimal to date.

In fact, the record shows that the long-running TV whitespace proceeding that touted dynamic spectrum sharing to support unlicensed devices has spawned inaccurate databases upon which protection to licensed services are to be based. The Commission's Part 15 rules require that unlicensed devices operating on TV white spaces (TVBDs) contact an authorized database system to obtain a list of channels that are available for their operation at a given location. TV whitespace devices are required to provide their geographic locations to the database they use through a secure Internet connection to a TV bands database system authorized by the Commission. When a TV whitespace device provides its location to its database, the database will then return a list of channels available for operation by the device at that location.

In an "Emergency Motion for Suspension of Operations and Petition for Rulemaking" the National Association of Broadcasters (NAB) stated the following concerning a TV whitespace database system:

...NAB has conducted multiple analyses of the TVWS database over the last year. At various points, more than one-third of the fixed TVBDs in the database contained patently inaccurate location information...³

NAB went on to provide some examples:

...NAB found one device registered as being located 30 miles from Quito, Ecuador. Another was registered to a spot in the Atlantic Ocean, about 500 miles off the coast of Cameroon. Our researchers found several dozen devices located at a single family home, numerous devices registered as being located in the middle of a street, and devices registered in the middle of empty fields. We found more than 20 devices registered to a location at a large water tower in Peru, Indiana, although all the devices were registered at two meters above ground.

Whether users are misusing the database because of concerns over providing their actual location, willful circumvention of the rules to operate on more channels than permitted, or sheer laziness, the result is the same: The significant number of false entries undercuts the

³ Emergency Motion for Suspension of Operations and Petition for Rulemaking submitted by the National Association of Broadcasters (NAB) March 19, 2015, at page 2.

integrity of the database and defeats its intended purpose.⁴

As recent as 2018, NAB still noted problems with TV whitespace databases.⁵

In addition, sensing-based unlicensed operation has been shown to interfere with licensed services, as evidenced by the Commission's own Enforcement Bureau records. The Commission's own website includes a section titled "U-NII and TDWR Interference Enforcement." This section sets forth a list of almost 50 enforcement cases between January, 2007 and November 2017 in which UNII devices have presented an interference conflict with Terminal Doppler Weather Radar (TDWR) systems operated by the Federal Aviation Administration (FAA), US Armed Forces and TV broadcast stations.⁶ The problem was significant enough to warrant Commission issuance of an Enforcement Advisory on September 27, 2012 to remind manufacturers, marketers and users of UNII devices of the applicable rules.⁷ Still, 23 enforcement cases are listed with dates subsequent to issuance of that advisory public notice.

Furthermore, in May 2018, Globalstar provided measurements showing a 2 dB rise in the noise floor in the 5 GHz band where it holds a license for uplinks and where unlicensed devices have been deployed. The Commission placed the Globalstar issue on Public Notice for comment, but to NPSTCs knowledge, no further action has been taken to address the concerns.

By comparison, the combination of the spectrum access system (SAS) and the environmental sensing capability (ESC) at 3.5 GHz appear to have the promise to be more robust mechanism's, when properly designed for the band in which they will be used. However, even the SAS and ESC mechanisms are recent developments in which usage so far has been primarily for testing. There has been no long-term period of operation for these tools to be proven reliable in the real world. In

⁴ NAB Emergency Motion for Suspension of Operations and Petition for Rulemaking, March 19, 2015, pages 10 and 11.

⁵ See <https://www.broadcastingcable.com/news/nab-white-spaces-database-still-not-ready-for-prime-time>

⁶ <https://www.fcc.gov/general/u-nii-and-tdwr-interference-enforcement>

⁷ Public Notice, DA 12-459, FCC Enforcement Advisory No. 2012-07, issued September 27, 2012. <https://docs.fcc.gov/public/attachments/DA-12-459A1.pdf>

addition, the spectrum environment at 3.5 GHz for which the SAS and ESC spectrum sharing tools are being developed has a significantly lighter load of primary operations to be protected than that which exist at 6 GHz.

In view of all the above, NPSTC seriously questions whether opening the heavily used 6 GHz band to millions of unlicensed devices at this time is sound spectrum policy, given the band serves as the foundation for critical microwave links relied upon by public safety, critical infrastructure entities, commercial carriers and broadcasters. However, members of the Commission do appear to have already decided to allow such sharing, even before any comments to the NPRM are received.⁸

Fortunately, the Notice of Proposed Rulemaking (NPRM) does include the Commission's commitment to protect licensed services in the 6 GHz band from interference that could occur from unlicensed operation in the band:

The new unlicensed use opportunities we propose are designed to protect important incumbent licensed services that operate (and continue to grow) in various sub-bands of this spectrum. Under the proposed rules, we believe that unlicensed use of the band will be compatible with these incumbent licensed services.⁹

Therefore, NPSTC provides recommendations and input to the numerous questions in the NPRM to help the Commission carry out that commitment to the maximum extent possible.

⁸ Chairman Pai's statement issued October 24 upon adoption of the 6 GHz NPRM stated, "We look forward to compiling a robust record and then acting quickly to make more 6 GHz spectrum available for unlicensed uses."

⁹ NPRM at paragraph 20.

NPSTC Recommendations and Input

In NPSTC's view, effective spectrum sharing depends on the 1) spectrum environment; 2) the reliability required by services in the band being protected; 3) the radio frequency (RF) laws of physics inherent in the band in which the sharing is proposed; 4) the rules adopted to protect operations in the band, 5) how well those rules are actually implemented by new entrants and enforced by the Commission; and 6) an effective mechanism to address expeditiously any interference that does occur in actual practice. If the Commission and rules developed in this proceeding do not adequately account for these factors, interference to critical licensed microwave operations could very well occur and the proposed spectrum sharing would be a failure.

Numerous comments and ex parte filings in the underlying Notice of Inquiry in this proceeding show the 6 GHz band spectrum environment. The band is heavily used for critical fixed links by public safety, critical infrastructure entities and commercial carriers. As the Commission acknowledged in the NPRM:

The fixed service is used for highly reliable point-to-point microwave links that support a variety of critical services such as public safety (including backhaul for police and fire vehicle dispatch), coordination of railroad train movements, control of natural gas and oil pipelines, management of electric grids, long-distance telephone service, and backhaul for commercial wireless providers such as traffic between commercial wireless base stations and wireline networks.¹⁰

A previous Ex Parte filing by AT&T included a map that depicts the heavy deployment of 6 GHz microwave links throughout the country.¹¹ It should be no surprise the band is heavily used. As a result of the Commission's reallocation of the 2 GHz band which had been a significant spectrum foundation for long microwave hops, the 6 GHz band has become more crowded. The 6 GHz band is the only current band available to support links of long distances, e.g., those greater than 30 miles.

¹⁰ NPRM at paragraph 9.

¹¹ AT&T Ex Parte filing, Gen Docket No. 17-183, March 19, 2018.

Furthermore, sites in the densely urban areas have congestion in all of the microwave bands, necessitating the band's use in many cases for links that are shorter than 30 miles. Simply assuming that fixed links can transition to other bands ignores the overall spectrum environment, as well as the environmental and fiscal impact of developing additional sites that would be required to support the additional hops in other (higher) RF bands to replicate the longer hops possible in the 6 GHz band. Additional hops also add undesirable latency, which some critical links will not tolerate.

Because of the criticality of licensed fixed links in the 6 GHz band, public safety agencies implementing such links specify a 99.999% (“5 nines”) or sometimes 99.9999% (“6 nines”) level of reliability. Accordingly, link design practices incorporate sufficient margin to maintain that level of reliability, taking into account multi-path fading, the vagaries of RF propagation, weather and other factors. Such fade margins, designed in on a 24/7 basis, are essential to maintain the operational level of reliability needed. Unfortunately, the NPRM seems to presume that fade margins can be eroded by at least 10 dB with no impact to the reliability of critical microwave links.¹² That is not the case. The Commission’s and unlicensed industry’s interest in spectrum sharing does not change the laws of physics of RF propagation. The implementation of spectrum sharing to accommodate unlicensed devices must not erode these fade margins, as doing so would reduce the level of reliability needed for critical fixed links.

The NPRM states that the fade margin required depends on the weather patterns in a given geographical area:

Outside low latitude coastal regions, atmospheric multipath fading occurs most often during humid seasons with low precipitation. Such seasonal atmospheric multipath fading depends strongly on geographical location and local weather patterns. Given that atmospheric

¹² NPRM, paragraphs 45 to 47.

conditions affect multipath fading, should the interference protection criteria be relaxed or other allowances made in areas where fades are not as prominent?¹³

While it is true that the fade margin and even need for space diversity antenna systems depend on the weather conditions among other factors, the engineering path models used for design already take weather and terrain into account when designing for a given path reliability margin.¹⁴ Given the modeling and expense to meet a specified fade margin for a path, it is highly doubtful there is any excess fade margin not required to maintain the engineered path reliability.

The NPRM also suggests in paragraph 47 that the fade margin could be reduced by 10 dB without harmful impact. Under the proposal, unlicensed devices would be prohibited from operating inside a 10 dB reduction contour. This seems to imply that a unlicensed device may reduce the fade margin up to 10 dB. Fade margin is directly related to path reliability and a 10 dB fade margin reduction would decrease reliability approximately by a factor of 10.¹⁵ As an example a path designed for 99.999 % reliability would be reduced to 99.99 % reliability. To further compound the problem, many systems use multiple paths in their systems. The reliability of a multi-path system is the sum of the “outage or unreliability” of each path in a multi-path system.¹⁶ For example for a 3 hop system with each hop designed for 99.999% reliability or .001% outage probability would have an overall reliability of 99.997%. Assuming all 3 paths are degraded by a factor of 10, the overall system reliability would degrade to 99.97% reliability. Of course, this would get even worse for multi-hop system with even more hops. In summary, the unlicensed devices cannot be allowed to degrade the fade margin of public safety systems nor can it be assumed there is any excess fade margin in any system.

¹³ NPRM, paragraph 46.

¹⁴ White, Robert F. (1975). Engineering Considerations for Microwave Communications Systems. GTE Lenkurt incorporated, page 55.

¹⁵ White, Robert F. (1975). Engineering Considerations for Microwave Communications Systems. GTE Lenkurt incorporated, pages 62 -63.

¹⁶ White, Robert F. (1975). Engineering Considerations for Microwave Communications Systems. GTE Lenkurt incorporated, page 111.

In addition, NPSTC recommends the following policies and rules if the Commission goes forward with unlicensed sharing in the 6 GHz band.

- NPSTC supports the proposal to protect both current and future licensed microwave links from interference. The continued ability for the public safety community and other licensees in the 6 GHz band to add new links and modify existing links without incurring interference from unlicensed devices is essential.
- In addition to permanent fixed links, the 6 GHz band supports temporary links. As examples, these are used for restoration of public safety communications following a natural disaster and for emergencies that require immediate fixed link support. These temporary facilities also must be protected from interference. Unlicensed devices should be prohibited on any 6 GHz band frequencies specifically designated for temporary links under Part 101 of the rules and additional steps should be taken to ensure temporary links authorized through a geographic license or special temporary authority are protected.
- NPSTC supports a centralized Automated Frequency Coordination (AFC) spectrum access system with up-to-date information and appropriate algorithms and protocols to define the Part 101 channels on which an access point and its associated client devices must avoid at a given location to prevent interference to licensed 6 GHz operations.
 - The access point must register its unit ID, position location, and power level with the AFC, which in turn provides the access point the microwave channels on which it must avoid operating.
 - To maintain an accurate record of the licensed facilities to be protected, the AFC system data base should be updated at least every 24 hours.
 - Any initial transmission to establish communications prior to receiving channel instructions from the AFC system should be conducted on unlicensed frequencies outside the 6 GHz band, e.g. on 5 GHz unlicensed frequencies or through other Internet connections.
 - If/when the access point changes location, and/or power level, the AFC needs to recalculate the Part 101 channels on which the access point may not operate.
 - By default, an unlicensed 6 GHz access point should be turned off unless it has a viable connection to the AFC that can provide instructions on the appropriate channels in a given area to avoid interference to authorized licensed 6 GHz systems. Once connected and operating, transmissions between an access point and associated client devices also should be suspended if/when connection to the AFC is lost.

- The control link between the AFC system and the unlicensed access point should be secure and encrypted. The AFC provider(s) should be required to use the best industry security measures and should be audited periodically for security practices.
 - The AFC should maintain a list of registered access points, accessible by unit ID and location, that can be accessed in the event an interference problem arises. Also, if an interference problem arises that creates a potential danger to public safety that must be resolved expeditiously, the AFC should incorporate the capability to instruct an access point to shut down.
 - If the AFC is centralized as NPSTC recommends, the algorithms and protocols can be updated as needed rather easily, as compared to updating every deployed access point and associated client device.
- NPSTC recommends that both outdoor and indoor access points be required to connect to the AFC. Indoor access points could still interfere with licensed 6 GHz facilities, especially if the access point/client devices are on the high floor of a multi-story building. Given the recent work to advance vertical (Z axis) location technologies for wireless 911 devices, it may also be possible to incorporate a cost effective vertical location solution into 6 GHz unlicensed devices. Registration of an access point's vertical location as well as horizontal location could lead to more accurate interference prediction determinations.
 - NPSTC understands the Fixed Wireless Communications Coalition (FWCC) has been deliberating on the appropriate propagation models and protection criteria to minimize interference to critical fixed links. NPSTC looks forward to reviewing FWCC's comments and recommendations on these points.
 - The Commission should implement trial testing requirements to demonstrate that the AFC, and representative sample access points and client devices operate correctly according to the protocols and algorithms adopted. Such testing should include trial operations in a variety of environments, including urban, suburban and rural. Regular deployment of 6 GHz access points and client devices should await affirmative results of such testing.
 - Also, once the AFC operation is confirmed with sample trial devices, the Commission should have an ongoing equipment certification program to approve unlicensed access points and client devices prior to their deployment.

NPSTC believes implementation of these steps will help protect critical fixed links in the 6 GHz band, and if properly implemented and enforced, can provide a mechanism to address any interference that does occur, despite everyone's best intentions.

Conclusion

NPSTC appreciates the opportunity to provide comments on proposed rules that could allow millions of unlicensed devices in the crowded 6 GHz band now used for critical microwave links by public safety, critical infrastructure, commercial carriers and broadcasters. Given the history of automated or dynamic spectrum sharing in TV whitespaces, interference that has occurred from unlicensed device operation in the 5 GHz band, and nascent sharing at 3.5 GHz through a spectrum access system and environmental sensing capability, NPSTC seriously questions whether unlicensed sharing in the critical 6 GHz band is sound spectrum policy. However, given the Commission's apparent interest in such sharing, NPSTC provides specific recommendations to help protect critical fixed microwave links in the band.

NPSTC supports a centralized dynamic spectrum access approach incorporating important details as spelled out in these comments to protect both current and future fixed microwave links. Such a centralized approach with appropriate algorithms, protocols and up-to-date information on authorized microwave links is an essential part of the protection the Commission has promised. In addition, these comments address steps that need to be taken in testing, equipment authorization, and enforcement to help ensure proper protection to microwave links, and expeditious resolution of any interference problems that do occur.

From a technical perspective, a five 9's and in some cases six 9's level of reliability is needed for critical public safety links. Maintaining these levels of reliability is accomplished through link designs with requisite levels of fade margin. Contrary to the Commission's proposal, such fade margins must not be eroded through the deployment of unlicensed devices. NPSTC also looks forward to additional comments submitted by other stakeholders in the 6 GHz band.

Douglas M. Aiken, Acting Chairman

A handwritten signature in cursive script, appearing to read "Doug M. Aiken".

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