

A Survey of Policy Issues in Spectrum Sharing in the 12 GHz Band

Erika Heeren-Moon, MA
Virginia Tech
Commonwealth Cyber Initiative
Arlington, VA
ORCID: 0000-0003-3263-9389

Dr. Eric Burger
Virginia Tech
Commonwealth Cyber Initiative
Arlington, VA
ORCID: 0000-0002-2143-9368

Abstract—When considering spectrum sharing, the concept of regulatory certainty drives regulators to consider worst-case scenarios to evaluate potential impacts to incumbents. If a second use will never interfere, then all is good. However, in scenarios where the worst case is unlikely to occur, it means alternate uses may not be considered, the alternate use may have unnecessary limitations, or the incumbent may lose access to the band if the new use is deemed in the public interest. This paper reviews the recent history and discourse associated with spectrum sharing in the 12 GHz band. The paper examines socioeconomic considerations of the band. Finally, opportunities for future policy research with a focus on developing a dynamic policy framework for coexistence between services in the band are presented.

Keywords—*Dynamic Spectrum Policy, Commercial Spectrum Allocation, Spectrum Sharing, Rural Digital Access*

I. INTRODUCTION

In January 2021, the Federal Communications Commission (FCC or “The Commission”) released a Notice of Proposed Rulemaking (NPRM) 20-443 to seek comment on how best to maximize use of 500 megahertz of mid-band spectrum between 12.2 – 12.7 GHz, also known as the 12 GHz band. Key issues raised by the NPRM include the propagation and capacity characteristics of the band, the nature of in-band and adjacent band incumbent use, and the potential for international harmonization. The Commission also sought comments on whether they could add a new or expanded terrestrial mobile allocation in the 12 GHz band without causing harmful interference to incumbent licensees [1].

As part of the SWIFT ASCENT joint coexistence research project, [7] we reviewed the NPRM and all comments filed and posted to the FCC’s ECFS system between December 2020 through May 2023. The filings and comments were reviewed individually and disseminated into core issues and proposed solutions. At the time of review, there were approximately 95,000 comments posted to the ECFS system related to the NPRM. The focus of this article is to provide context to the socioeconomic issues that were identified and regulatory compliance opportunities.

We note that additional comments have been submitted since the FCC’s decision was posted, and additional proceedings are in progress. The purpose of this article is to provide context and an analysis of the key issues raised and the different arguments presented. Ultimately, this paper will provide context for ongoing discourse surrounding the spectrum sharing topic in general.

In addition, we note that there are international considerations and licensing decisions that may influence this discussion. This article explores the U.S. policy and history surrounding the 12 GHz spectrum sharing debate. This article does not address the international impact and influence of spectrum sharing on the 12 GHz band and beyond, though this is a fascinating opportunity for future research.

Finally, we note that there are adjacent channel concerns identified in the NPRM, which have been explored in previous articles. [4] The focus of this article is the spectrum between 12.2 and 12.7 GHz.

II. BACKGROUND

The commodity in question is the mid-band spectrum that lies between 12.2 GHz and 12.7 GHz. This is frequently referred to as the “12 GHz band” in the NPRM, filings, and comments from interested parties posted on the ECFS system. Currently, the 12 GHz band is shared by three non-federal groups. This includes Direct Broadcast Satellite (DBS) providers, Multichannel Video and Data Distribution Service (MVDDS) providers, and non-geostationary satellite orbit fixed satellite service (NGSO FSS) providers. [1]

A. Why 12 GHz?

As the FCC identified in the NPRM, the mid-band spectrum between 12.2 GHz and 12.7 GHz is well suited for next-gen wireless broadband due to the combination of favorable propagation characteristics (compared to higher bands) and the opportunity for additional channel re-use (compared to lower bands). [1]

From a socioeconomic perspective, the unique characteristics of the 12 GHz band create an environment of opportunity. To understand the best use of the band, it is vital to look beyond what is best right now versus what will be best in the near and possible future. The services provided by the NGSO FSS and DBS providers, particularly in the rural areas of the United States, are important services. At the same time, the possibilities of 5G connectivity in multiple markets – for rural, urban, and suburban environments – is vast.

For terrestrial systems, this band would require fewer towers than higher bands, and therefore substantial potential cost advantages, positively impacting affordability. 5G mobile terrestrial goes beyond residential connectivity. It is the foundation on which the Internet of Things (IoT) is likely to fully deploy across a wide range of industries. Inter-device connectivity is a

unique aspect of 5G and other mobile terrestrial services, unavailable to NGSO or DBS services. At the same time, there is a need to avoid a disconnect between the established NGSO and DBS providers using the band and their existing customers. Incumbent considerations such as existing and future jobs created by the commercial providers of these services require stability in the band or an appropriate alternative.

B. Commission Approach

The information in this section is derived from the original NPRM. [1]. At the time the comments were reviewed, the Commission rules were as follows. The Commission enables sharing between co-primary NGSO FSS and MVDDS. Service rules for MVDDS permit one-way digital fixed non-broadcast service, including one-way direct-to-home/office wireless service. The rules limit the effective isotropic radiated power (EIRP) for MVDDS stations to 14.0 dBm per 24 megahertz (-16.0 dBW per 24 megahertz). A MVDDS licensee may not begin operations unless it can ensure that the equivalent power flux density (EPFD) from a proposed transmitting antenna does not exceed the applicable EPFD limit at any DBS subscriber location. Initially, MVDDS must survey the service area to determine the location of DBS customers and remediate all complaints of interference. Then, the burden shifts to DBS licensees for new customers to consider the presence of the MVDDS licensee and must remediate all complaints of interference. Finally, NGSO FSS receivers and MVDDS transmitting systems are afforded priority in the 12 GHz band portion of spectrum vis-a-vis each other based on which was deployed earlier.

In 2016, the MVDDS 5G Coalition filed a Petition for Rule-making requesting reforms for the 12 GHz band. These included adding a mobile allocation at 12.2-12.7 GHz. They requested that the unused NGSO FSS allocation on this band be deleted or demoted to secondary status. In addition, the petition requested that MVDDS licensees provide two-way, point-to-point, or mobile broadband services and eliminate the MVDDS EIRP limits. At the time, the Coalition released two coexistence studies that it claimed demonstrated that the new rules would protect DBS operators in the band, but they would be incompatible with NGSO FSS downlink operations. [5]

In 2017, the Commission granted the first of the MVDDS requests. However, the Commission concluded that the MVDDS 5G Coalition's petition was not a sufficient reason to delay or deny NGSO requests to use the band at the time.

In 2021, the 12 GHz NPRM was released, leading to the current discussion. The NPRM raised several opportunities for allocation and sharing on the band including adding mobile licenses to current providers, geographic sharing, and dynamic sharing through Spectrum Access Service (SAS) as used in the 3.55-3.7 GHz band. [1]

Ultimately, the FCC voted in 2023 to not authorize high-power mobile terrestrial use in the 12.2 – 12.7 GHz band at this time and opened the opportunity for additional commentary. [2]

III. KEY ISSUES & DISCOURSE

Currently, in a conflict between two or more interests on a given spectrum, the FCC considers the incumbent use first. Often, the incumbent service provider has invested financially

and through workforce development to accomplish the goals of expanding digital access. However, it is not always clear if the incumbent's progress is sufficient to remain the priority provider in the band. Still, new technologies, new services, and new market segments develop over time. For the most part, the FCC creates static policies. These policies often consider the worst-case potential for interference with the incumbent. This has the benefit of providing bright lines if there is sharing. However, it can also cut off sharing possibilities. Conversely, the incumbent may lose access to the band if the FCC determines it is in the public interest for the new service to operate.

A. Will Harmful Interference Occur?

The 12 GHz band has propagation characteristics that vary with the context, such as the weather. If a policy could be developed that honored the dynamic nature of the band, then sharing might be possible. The discussion surrounding the use of spectrum in the 12 GHz band presents an opportunity for the development of one or more tools that can be used to make the process of spectrum allocation more efficient in the future.

Today, if there is even a minor potential for interference, the allocation is often denied on the possible chance that it may cause an issue to an incumbent. However, the consideration for determining fair and best use on any given spectrum extends far beyond this question. The reality is that there are opportunities for spectrum sharing that vary based on a variety of factors that change over time. The current practice presents a challenging environment where decisions on spectrum allocation are often made without a holistic view of the situation. This is explored further in Section V of this article.

B. If Harmful Interference is Likely to Occur, Which Service Should Prevail on the Band?

Since the FCC typically looks for extremely low interference, the conversation surrounding allocation of spectrum in the 12 GHz band has created contention from both the MVDDS and NGSO sides of the spectrum sharing issue. While the 12 GHz band is well suited to 5G initiatives, NGSO providers are already using the band and have invested substantially toward developing their services in the band. The question becomes; can the two services coexist in the band? If they can, what parameters are necessary to ensure access and quality control for both services? If they cannot, which service should take precedence? Finally, what implications would a decision one way or another have on future regulation regarding spectrum sharing? Unfortunately, a clear answer has yet to be provided.

MVDDS advocates argue that updating the rules for MVDDS licensees – thereby increasing terrestrial use of the 12 GHz band for two-way communication and mobile and fixed service – is in line with existing FCC priorities surrounding 5G development. In addition, MVDDS advocates emphasize that the realities of spectrum sharing as it relates to promoting innovation and next-generation connectivity within the United States requires a proactive and forward-looking approach to regulating the band. As a result, these proponents of MVDDS and mobile terrestrial use argue that expanding MVDDS use in the band is in the best interest of the American public. Expanding the use of the band, they claim, encourages competition by delivering more choices and lower costs for consumers.

MVDDS advocates released a new study they claim reverses the original analysis that MVDDS and NGSO services cannot coexist in the 12 GHz band. [6] They state that the original analysis was a “worst-case scenario” – and when properly planned, the two services can coexist effectively. At the same time, MVDDS petitioners note that if this approach is not compatible with the goals of NGSO, then NGSO services should be removed and MVDDS services should be prioritized as the “highest and best use” for the 12 GHz band.

NGSO providers and supporters argue that the MVDDS advocates have not provided enough evidence to support the claim that MVDDS terrestrial services and NGSO services can coexist in the band. NGSO providers contend that they have existing and established commercial and public service initiatives in place. MVDDS licensees have yet to establish functional services on the band, even with the original release of the spectrum for MVDDS use. MVDDS advocates counter that the restrictions and rules associated with the auctioned licenses have been costly and prohibitive, delaying otherwise potentially rapid deployment of terrestrial services. Still, NGSO advocates refer to their established services that have been deployed for use by underserved citizens through their initiatives as reason to claim NGSO services as “highest and best use” of the band.

Additional considerations involve a cost analysis of moving these services to another band, which someone would need to bear. This can impact revenue, job creation, and service capacity for existing, new, and expanding NGSO services. NGSO providers argue that the MVDDS services cannot coexist with their services, therefore MVDDS should be removed from the band.

C. If Harmful Interference Cannot Be Realistically Determined, Which Service Should Prevail on the Band?

Another key issue raised in the discussion concerning harmful interference in the 12 GHz band is whether the studies presented by the parties would be accurate to real-life scenarios. Currently, the studies presented tend to veer consistently toward the worst-case scenario. This creates an issue for ongoing spectrum sharing policy for the 12 GHz band and beyond. If the decisions regarding spectrum use are consistently based on worst-case scenarios, a stalemate of sorts is almost inevitable.

Providers that responded to the NPRM seemed to be split on their analysis of expanding MVDDS use in the band. Some echo the argument that terrestrial mobile services are “fundamentally incompatible with satellite services, including DBS operations.” [2] They contend that the proposed changes could substantially redefine the scope of the burden on DBS providers, again speaking to service capacity, revenue, and job creation concerns. DBS providers also allege that since the MVDDS providers have not effectively demonstrated that their services would not interfere with existing DBS initiatives, MVDDS providers should not be granted expanded access. Yet, some of the DBS providers argued that the studies presented can be interpreted as evidence in favor of coexistence. [3]

There are allegations that some of the commentators are driving their analysis based on corporate interests. However, other commentators note that this position makes the companies uniquely suited to respond to concerns, having investments in both services simultaneously. Specifically, advances in

technology, the amount of spectrum still available to NGSOs, and examples of flexibility for adapting to changing regulations on international spectrum were cited as reasons to support increased MVDDS use.

IV. DECISION

In May of 2023, the FCC released a decision on the 12 GHz NPRM proceedings. The Commission concluded that since the degree of potential interference was too uncertain to risk, the 12.2 GHz band is reserved for satellite services. Meanwhile, the FCC has released NPRM 23-36 proposing to repurpose some or all the 12.7 GHz band for mobile terrestrial use. [1]

V. WHERE DO WE GO FROM HERE?

To be equitable and forward thinking in an approach to commercial spectrum allocation, the FCC requires a more dynamic framework to accommodate often conflicting needs of corporate entities providing the service, technical parameters, and the long-term goals and benefits for users nationwide.

Today, the FCC often determines spectrum allocation based on worst-case scenarios from singularly focused interference analyses. From a policy standpoint, this has created an environment where a binary “yes” or “no” response to allowing a provider on a given spectrum band was the most straightforward way to make a decision that can be reasonably explained to the providers and the public.

The 12 GHz band presents a unique opportunity due to propagation characteristics that change dramatically based on environmental circumstances. This provides an opportunity to take a different approach. Rather than simulating interference in the worst-case scenario, a dynamic model using a variety of changing environmental, topographical, and population considerations would empower regulators to create a framework that allows for coexistence in the band recognizing the propagation parameters are not fixed. [7] Figure 1 presents a proposed policy framework to analyze potential coexistence in a given spectrum band.

Under the current approach, the FCC reviews whether interference will occur in a worst-case scenario and bases its decision on that information. The decision generally has two possible outcomes – if interference might occur, the new service cannot use the band, or the incumbent loses access to the band. If the interference is unlikely to occur, the new service may be able to use the band. However, that approach fails to consider that dynamic environmental, topographical, and population considerations that would allow both services to operate in the band in many situations.

For example, the FCC will assume that the power required to mobile terrestrial services will remain constant regardless of changes in the weather. However, on a foggy or cloudy day, the mobile terrestrial service may be able to operate at a higher power and not interfere with an NGSO or DBS incumbent provider. The current FCC approach assumes the same power usage on a cloudy day and a clear sunny day – when interference may occur.

As a result, service providers argue in the absolute as well. This was evident in the arguments presented in the comments

Interference Policy Framework

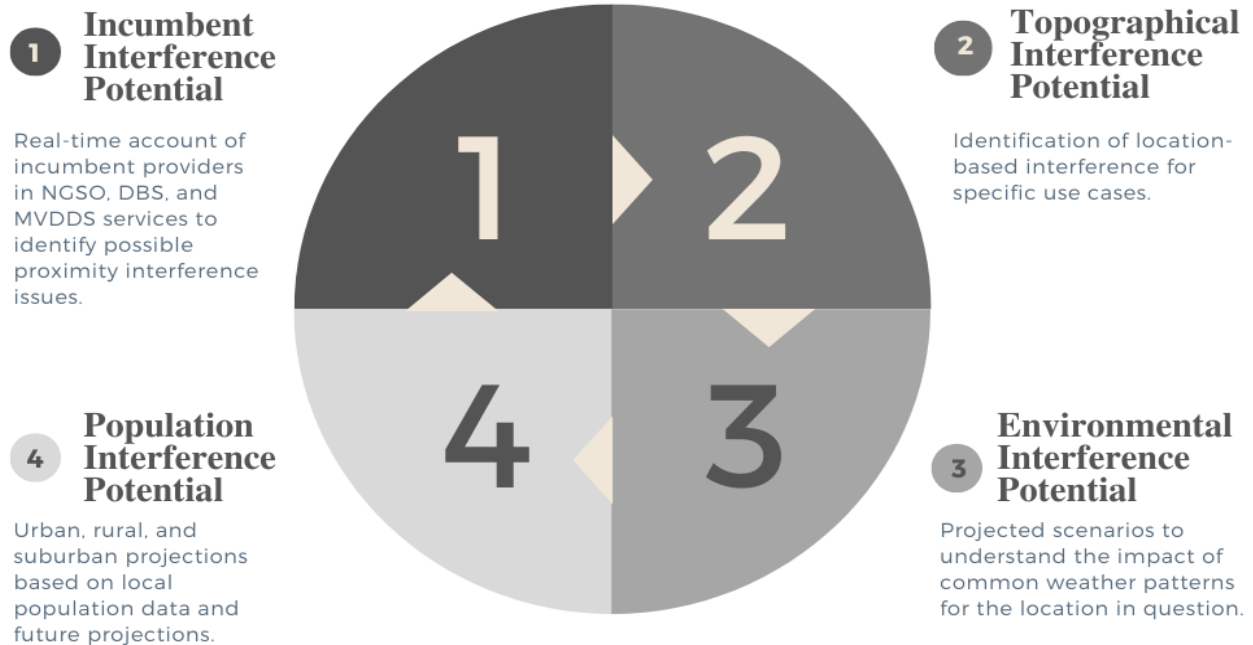


Figure 1: Interference Policy Framework

submitted to the FCC in response to the NPRM. Since interference may occur in any worst-case scenario, providers tend to lean on whose service is more valid for the public as the basis for their argument – because the alternative is that they won’t be able to utilize that spectrum at all. The resulting claims and counterclaims are often biased toward corporate goals and make it challenging for a regulator to make a holistic and realistic analysis based on unbiased, reliable information.

A. A Reliable and Accurate Method for Testing for Interference

One of the challenges facing spectrum licensing decision makers is which argument is most accurate, and which provider is serving the best interests of the public? A simulation tool – or a collection of tools – that can be used to accurately determine interference potential on a case-by-case scenario would allow policymakers to better understand individual scenarios. This has been explored in recent research. [9]

Figure 1 identifies core issues that must be considered in making a sound policy decision. As of now, there are proposed tools that meet one or two of these items separately. However, for policy decisions, a collection of tools that funnels data in each of these categories into a digestible analysis framework to identify the best use on a scoring system would reduce blind spots in spectrum sharing and allocation decisions. This tool

would potentially be able to help policymakers answer a broader range of questions that present a clear vision of what actual use on the spectrum would look like in any given situation. For example: In what specific circumstances will interference occur? In which specific circumstances will the interference become harmful? What environmental factors need to be considered in this specific use case – such as the example of power required for mobile terrestrial on a cloudy day versus a sunny day in the beginning of Section V? With this information, a clear and realistic view of the potential situation in question is developed. [8] More importantly, it could empower the regulator to develop dynamic sharing policies, enabling sharing most of the time where in the past the regulator would be forced to pick one service or the other.

An accessible simulation tool leveraged by service providers, academics, and the regulatory agency would open the door to a more efficient policy structure that can avoid situations where decisions are based on requiring that no interference be present at any point in the band in any scenario. The information could be tested and applied for different bands and case-by-case scenarios in a cost-efficient manner. While a single tool may not be able to accommodate all the considerations noted in Figure 1, a dynamic multi-tool approach [7] would empower policymakers, academia, and the private sector to make the best and most

fair use of the spectrum in question and reduce the clouding of an issue with inaccurate or biased arguments.

B. Equity in Weighing Socioeconomic Factors

In addition to technical and environmental issues, additional considerations come to play in the long and short term of spectrum allocation policy. Specifically, how can the FCC weigh ongoing access in rural, suburban, and urban communities? There is substantial discussion of job creation, but where are the jobs being created, and which local economies benefit? Does the allocation of a specific band of spectrum truly fit the best public use overall? A deeper demographic and service distribution analysis will be required to explore this topic further.

VI. CONCLUSION

The 12 GHz spectrum allocation and coexistence discussion has demonstrated a strong need for a new approach to spectrum allocation. Recognizing the 12 GHz band has dynamic propagation properties, we can have dynamic spectrum policies. As this issue is ongoing, there is an opportunity to use the 12 GHz band as a case study for new and innovative tools to assist in maximizing and protecting the best use(s) for the public good.

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