Insight

Probabilistic Interference Assessments in Spectrum Policy

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Executive Summary

- The Federal Communications Commission (FCC) has traditionally relied upon worst-case scenario analysis to determine whether new entrants to certain bandwidths will cause harmful interference to incumbent operators.
- Increased congestion of radio operations has made this traditional model of interference assessment untenable as it often forecloses the possibility of new entrants regardless of the actual risk of harmful interference.
- The FCC has begun to use probabilistic assessments to evaluate interference risks, and the courts have largely approved this approach.
- The FCC should continue to rely on probabilistic analysis in new bands to better evaluate the relative risks of harmful interference and the potential impacts that such interference will have on incumbent operations.

Introduction

The current radio environment is becoming increasingly congested. While greater wireless usage from services such as 5G mobile networks and Wi-Fi hotspots creates significant benefits for consumers, the receivers in our devices must filter out additional "noise" as more radios operate in the field. The Federal Communications Commission (FCC) has taken significant strides to allow for an increase in the number of concurrent operations, but challenges will persist unless regulators embrace a more nuanced view of potential harmful interference.

Traditionally, spectrum management decisions were based on impact estimates using deterministic, single-value calculations that employ worst-case scenarios. This approach results in an overly conservative management regime that often prevents the deployment of new services even if the likelihood of harmful interference, and the potential impact if harmful interference did occur, remained relatively insignificant. As regulators consider potential changes to the spectrum management process in the United States, they should emphasize probabilistic interference assessments that better account for the actual operating parameters in the field, as well as the actual impact the interference will have on operations. Doing so would provide regulators with a more complete picture of the radio environment when determining whether new services can be deployed and operate, allowing for increased spectrum efficiency in the United States.

What Is Probabilistic Interference Assessment?

When determining whether to grant operating rights to new entrants, federal regulators must balance the interests of a wide range of parties, including new entrants and incumbents, as well as the public at large. Traditionally, the FCC has relied on worst-case scenario analysis, which attempts to determine what would happen if things went wrong. This approach has worked to ensure that incumbent operations can continue

without disruption as new entrants begin to operate.

The security of a worst-case analysis comes with trade-offs, however. First, the analysis often results in an overly conservative estimation of the chance and impact of harmful interference. Second, the analysis removes incentives and responsibility for incumbents to improve equipment to adequately filter additional noise. Interference occurs at the receiver level — the part of a device that receives the desired signal and filters out the unwanted noise. As older devices become outdated, they often fall behind their more advanced counterparts that can better filter noise; thus, older devices often experience harmful interference while a more advanced device would not. If the FCC wants to maximize the efficiency of radio operations, it must also consider ways of upgrading and modernizing outdated receivers. A worst-case scenario approach instead tends to lead to the view that adding additional operations into the field would seldom be worth the risks.

Probabilistic interference assessments broaden the analysis beyond "What's the worst that can happen?" to "What can happen, how likely is it, and what are the consequences?" To make this determination, the regulator takes an inventory of all significant harmful interference hazards, characterizes the hazards in a uniform way, and assesses the likelihood of the consequences of each hazard. Such an approach still relies on the judgment of the regulator to determine what types of risks are acceptable, and it wouldn't mean every new entrant would receive FCC approval: Some harms would still outweigh the benefits of new entrants. It would, however, ensure that the FCC approaches the problem with a full understanding of the likely outcomes, as well as potentially allow for the identification of unexpected harmful interference before a rulemaking is complete, rather than just looking at the worst-case scenario in isolation.

The 6 GHz Decision and the FCC's Authority to Rely on Probabilistic Risk Assessments

The FCC has broad authority to regulate the use of radio technology, but courts can still overturn a decision if they find that an agency failed to fully consider the record or otherwise comply with the Communications Act or Administrative Procedure Act. Therefore, as the FCC has begun to rely on probabilistic risk assessments, some incumbents have argued that the agency cannot use this analysis. The D.C. Circuit explicitly rejected this argument, however, in the 6 GHz case, which was a challenge to the FCC's decision to reallocate a significant amount of bandwidth to unlicensed operations.

In April 2020, the FCC reallocated the 6 GHz band for unlicensed uses such as Wi-Fi and Bluetooth. In its analysis, the FCC determined that unlicensed operations in the band would not interfere with incumbents' fixed microwave receivers in the band by relying on a probabilistic study done by CableLabs. The CableLabs study employed a probabilistic approach to identify interference risk, running simulations that incorporate a wide range of values based on the probability those values will be met in real-world conditions.

At the same time, additional analysis using worst-case scenarios seemingly showed the opposite. If the FCC continued to rely on worst-case scenario analysis, this counter-study would likely prevent unlicensed operations in the band and stifling deployment. The FCC dismissed these concerns, however, noting that a multitude of probabilistic factors must be considered when assessing the risk of harmful interference. It further noted that CableLab's probabilistic study showed that every parameter (e.g., building entry loss, clutter loss, same channel operation, being located in the same area, etc.) being the worst-case value at the same place and time is extremely low.

The D.C. Circuit reviewed a challenge to the 6 GHz order, addressing the question of worst-case versus probabilistic interference assessments. Central to the decision, the court attempted to determine if the FCC acted

arbitrarily and capriciously when discounting the worst-case studies in the record and relied instead on CableLabs' probabilistic analysis. In analyzing the decision-making of the FCC, the court focused on process rather than outcomes: As long as the FCC fully considered the arguments against the study and accounted for them in the order, the court would defer to the FCC's expertise.

Critically, this decision affirmed that the FCC need not "eliminate all risk of harmful interference," but rather determine that "the potential for harmful interference to incumbent services operating in the 6 GHz band is insignificant." As the court explained, neither the Communications Act nor the Administrative Procedure Act bars the FCC from relying on probabilistic assessments to determine the likelihood of harmful interference, nor does the law require the agency to prove that no harmful interference will occur. Instead, as long as the FCC fully considers the arguments in the record, it can rely on probabilistic analysis provided that evidence justifies its ultimate decision.

The FCC and Probabilistic Interference Assessments Moving Forward

As the FCC considers new allocations and assignments, it should increasingly turn to probabilistic assessments that fully consider the multitude of potential harms and the likelihood that they will occur. To do so, some experts have suggested slowly incorporating the approach into additional bands.

For example, one study analyzed the relative risks of harmful interference as additional non-geostationary-satellite orbit (NGSO) constellations are introduced and the number of satellites concurrently operating is increased. These new satellite constellations present significant opportunities for expanding broadband coverage, especially in rural areas where laying fiber lines expanding mobile networks is financially difficult due to sparse populations. Existing satellite operations could face harmful interference from additional constellations, however. The threat of harmful interference may seem obvious, but the study goes beyond worst-case scenarios to show that the probability of harmful interference, specifically in the Ka-band and V-band, is low, and the need for interference mitigation would be limited. At the same time, the study doesn't discount the need for mitigation entirely, noting that potential mitigation strategies would likely need to include some form of coordination between operators.

This type of analysis should be expanded into proceedings such as those over the 12.2-12.7 GHz docket. Currently, the band is allocated for a variety of services, specifically Direct Broadcast Satellite (DBS) television, Multi-Channel Video and Data Distribution Service (MVDDS) and NGSO broadband. MVDDS licensees, and one DBS licensee, want to expand the terrestrial rights of the current MVDDS licenses to provide 5G wireless service to consumers. Yet questions remain about how an expansion of the operating rights would impact incumbent operations, most notably to the NGSO operations in the band. As it stands, the dispute is largely a technical one, meaning it will be up to the engineers to determine what can and can't be done in the band. Nevertheless, both sides are vigorously arguing their respective positions, with the NGSOs arguing that any new terrestrial rights will cause harmful interference and the MVDDS operators arguing the opposite.

As the FCC evaluates the technical record in the docket, it should embrace the probabilistic analysis it used in the 6 GHz band. That doesn't mean it should necessarily determine that the two services could coexist or that FCC should expand the rights of the licenses, but the FCC should not simply look at worst-case scenario analysis and stop the discussion there. Due to the technical nature of the dispute, this band presents the FCC with a good opportunity to expand on its work with probabilistic interference assessments and to evaluate the usefulness of such an approach moving forward.

Conclusion

Interference disputes are here to stay, and the FCC will need to make difficult decisions in almost every proceeding about the relative risks to incumbent operations and the benefits that come with new entry. As it balances these considerations, the FCC should rely not on a worst-case analysis that almost immediately forecloses any new entry, but instead on probabilistic interference assessments to better evaluate the relative risks of harmful interference and the potential impacts that such interference will have on incumbent operations. While the FCC may still decide that two services cannot coexist in the 12 GHz, or that it cannot define specific mitigation strategies, the decision should stem from a complete analysis of the potential harms and the likelihood of those harms occurring.