

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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

NOTICE OF INQUIRY COMMENTS OF INTEL CORPORATION

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I. Introduction and summary

Intel Corporation (“Intel”) respectfully submits this comment in the Commission’s Notice of Inquiry on expanding flexible use in the mid-band spectrum between 3.7 and 24 GHz.¹ Intel is a leader in designing and building the essential technologies that serve as the foundation for the world's computing and communications devices. We strongly back the Commission’s efforts to make mid-band spectrum available for terrestrial mobile broadband use expeditiously and flexibly.

Intel applauds the Commission for initiating this Notice of Inquiry, as we believe both licensed and unlicensed mid-band spectrum allocations are necessary to fulfill the tremendous opportunity for future 5G applications and services. While the 3700-4200 MHz and 5925-7125 MHz frequency ranges called out in the NOI are occupied by incumbent users, Intel believes the rapid introduction of terrestrial mobile broadband services is feasible in these bands while respecting the rights of incumbent users.

Intel recommends that the Commission take a highly flexible and investment-friendly approach to make the mid-band spectrum available. Accordingly, Intel supports flexible licensing for terrestrial mobile broadband use of the 3700-4200 MHz band and unlicensed Part 15 operations for the 5925-7125 MHz frequency range to enable applications such as Wi-Fi™.

Intel believes the Commission can leverage the broad ecosystem participation and secure U.S. 5G leadership for both licensed and unlicensed technologies and maximize the benefits to U.S. consumers and businesses by proceeding expeditiously to an NPRM. To that end, we have worked diligently with a wide range of individual stakeholders, coalitions, and industry trade associations to take

¹ *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Inquiry, GN Docket No. 17-183, Adopted and released August 3, 2017 (“NOI”)

steps towards solutions that would quickly and efficiently enable access to mid-band spectrum for terrestrial mobile broadband use.

II. Access to mid-band spectrum, an integral component of the low, mid, and high-band spectrum inventory needed to realize the promise of 5G, is currently deficient.

A. Significance of mid-band spectrum

The Commission can fulfill an important need by making available additional mid-band spectrum (both licensed and unlicensed) with the bandwidth to support the larger contiguous channels required for high-capacity applications such as high-definition video and high-capacity extensions to macro-cell networks. For some applications which do not require high capacity and large channels, the existing 3.5 and 5 GHz allocations could certainly be utilized. However, the only current alternative for supporting multiple simultaneous high capacity applications is the high-band millimeter wave (“mmW”) spectrum, which is subject to propagation and penetration limitations by virtue of laws of physics. These limitations are greatly reduced for frequencies in the mid-bands.

Intel believes the mid-band spectrum teed up in this NOI holds great potential for offering a variety of innovative licensed and unlicensed 5G services, especially when combined with the adjacent 5 GHz unlicensed bands (relative to the 5925-7125 MHz frequency range) and the 3.5 GHz “CBRS” band (which is adjacent to the 3700-4200 MHz band). The 5 GHz and 3.4-3.8 GHz bands are either already supported in existing equipment in many parts of the world or are under development for imminent deployments and can therefore benefit from equipment design extensions and economies of scale. For these reasons, Intel encourages the Commission to move promptly to the NPRM stage for the 3700-4200 MHz and the 5925-7125 MHz frequency ranges.

B. Current status of the low, mid, and high-band spectrum inventory

5G networks will require access to sufficient low, mid, and high-band spectrum in order to deliver the usage scenarios envisioned for 5G. Upon the closing of this year's successful Incentive Auction for the 600 MHz band, and combined with both licensed and unlicensed spectrum below 3 GHz made available in prior years, the U.S. is a leader in getting low-band spectrum to the marketplace. In many countries, sufficient low-band spectrum is still not available for mobile broadband use. If the Commission issues a Report and Order for the additional mmW spectrum teed up in the mmW FNPRM and an Order on Reconsideration resolving the petitioned issues from the first mmW Report and Order² by the close of 2017, it will solidify U.S. leadership in bringing high-band spectrum to the marketplace. While some mid-band spectrum is currently allocated in the U.S. (the 3.5 GHz "CBRS band" and the 5 GHz U-NII bands), the amount of spectrum available to support 5G applications in these bands is limited, and more is needed.

C. Importance of mid-band spectrum for U.S. leadership in 5G

Due to the attractive combination of favorable propagation characteristics and wider channel bandwidths, access to mid-band spectrum has quickly become a priority for regulators in other parts of the world (*e.g.* Europe, China, South Korea, India, and Singapore, etc.). Regulators are taking steps to make this mid-band spectrum available to facilitate access to high data rates and new applications.³

² *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, et al.*, Report and Order and Further Notice of Proposed Rulemaking, GN Docket No. 14-177, Released July 14, 2016.

³ For example, see 5G Americas' *5G Spectrum Recommendations*, for an overview of 5G spectrum activities around the world, available at:

http://www.5gamericas.org/files/9114/9324/1786/5GA_5G_Spectrum_Recommendations_2017_FINAL.pdf

The mid-band spectrum gap with other nations can be readily closed if the Commission moves expeditiously. Beyond the U.S. leadership rationale, mid-band spectrum is a vital and simultaneously necessary component of the low, mid, and high band spectrum inventory required to realize the promise of 5G for consumers and businesses.

III. The 3700-4200 MHz band should be opened for licensed terrestrial mobile use under a flexible, market-based incentive approach.

Intel proposes that the most efficient and expeditious means of introducing terrestrial mobile broadband in the 3700-4200 MHz band is to create flexible market-based incentives for Fixed Satellite Service “FSS” space station incumbents to undertake voluntarily the process of clearing portions of the C-band downlink (3700-4200 MHz) spectrum in specific areas across the country. Intel encourages the Commission to allow co-primary terrestrial mobile operations in the 3700-4200 MHz band through commercial agreements between terrestrial mobile interests and FSS satellite operators. This approach would serve the public interest by creating a “win-win” situation in which satellite operations would be able to remain in the band while new terrestrial 5G networks could be deployed quickly. A key advantage of this approach is that it places the implementation decisions in the hands of the entities that face the opportunity cost trade-offs based on first-hand knowledge and the technical expertise to successfully implement this plan. Further details of this proposal can be found in Intel’s joint comments filed with Intelsat on October 2, 2017 in this proceeding.

IV. The 5925-7125 MHz band should be opened for unlicensed terrestrial mobile use while protecting incumbent users.

Incumbent deployments exist throughout the 5925-7125 MHz bands, with more than 50,000 registered licenses and approximately 100,000 corresponding links, deployed under more than a dozen different Radio Service Codes (although a majority of the assigned licenses occur in three Radio Service Codes within the Microwave service category). In light of this density, Intel believes the 1200 MHz within the 5925-7125 MHz range would be most conducive to Part 15 unlicensed broadband use for applications such as Wi-Fi, under the established Part 15 usage constraints of causing no harmful interference and receiving no protection from harmful interference.⁴ However, within that 1200 MHz range, and considering the density of incumbents, it may be the case that outdoor Part 15 use in certain portions of that bandwidth, and in certain geographic areas, could be subject to usage restrictions.

One way to partition the Part 15 unlicensed broadband operations into more manageable subsets for rulemaking purposes is to separate the requirements into indoor and outdoor usage scenarios. Accordingly, relative to indoor usage, Intel proposes that the Commission expeditiously enter the NPRM phase with a rebuttable presumption that rules can be crafted such that indoor Part 15 use could be feasible in all, or nearly all, geographic areas across the full 5925-7125 MHz band—under a common set of rules. Relative to outdoor use, we believe rules can be crafted with appropriate protections and mitigation techniques to allow for outdoor unlicensed Part 15 use, but we recognize that outdoor coexistence assessments for this band are more complex, involving more variables due to the many types of incumbent uses. Those assessments (including studies submitted by stakeholders

⁴ 47 CFR §15.5.

during the NPRM phase) will likely need to consider outdoor operations proximate to incumbent operations on a frequency sub-band basis, and possibly with geographic partitioning.⁵

Stated differently, it could be advantageous if the interference mitigation techniques for outdoor operation were partitioned into a small number of frequency sub-bands within the 5925-7125 MHz range (*e.g.* to reflect mitigation techniques optimized for certain incumbent service category groupings). This would avoid a single, lowest-common-denominator mitigation requirement that would be overly strict and result in highly-inefficient utilization for unlicensed users in certain portions of the band. However, this approach would only be recommended if the engineering studies conclude that partitioning outdoor use into sub-bands is advantageous compared to a single common mitigation plan for the entire band.

Among the *possible* mitigation techniques to be analyzed for applicability and/or feasibility for outdoor operation in the NPRM stage of this proceeding are: frequency and/or location-dependent power limits; detect and avoid; various forms of database authorization based on location, and proven relevant techniques borrowed from the 5 GHz U-NII bands.

V. Conclusions

Intel strongly supports the Commission's efforts to make mid-band spectrum available for terrestrial mobile (5G) broadband use expeditiously and flexibly. Specifically, Intel supports flexible

⁵ The FCC moved similarly by developing rules for indoor access in 5150-5250 MHz, then later expanding rules and associated conditions in order to facilitate outdoor access. In this NOI, we believe the Commission and relevant stakeholders should consider outdoor use simultaneously, not sequentially. However, since the scale and scope of coexistence analysis differs substantially between indoor and outdoor use in these bands, maintaining separate paths could enhance rulemaking efficiency.

licensing for terrestrial mobile use within the 3700-4200 MHz band and unlicensed Part 15 use in the 5925-7125 MHz band, in a manner that respects the rights of incumbent users.

Respectfully submitted,

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