Feasibility of Commercial Wireless Services Sharing with Federal Operations in the 3100-3550 MHz Band

U.S. Department of Commerce

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Table of Contents

EXECUTIVE SUMMARY

As directed by the MOBILE NOW Act of 2018, the National Telecommunications and Information Administration (NTIA) evaluated the feasibility of allowing commercial wireless services, on both a licensed and unlicensed basis, to share use of the radio frequency spectrum at 3100-3550 MHz, under the assumption of no changes in incumbent operations, except for possibly limiting some use of airborne radar systems over the continental United States. NTIA, in carrying out its mandate to manage federal spectrum, seeks to balance mission effectiveness and spectrum efficiency. As requested by Congress, this report focuses on creating opportunities for commercial use by sharing rather than by clearing the spectrum. At the same time, the Administration is increasingly focused on clearing spectrum where feasible.

These frequencies fall within the broader mid-band spectrum range widely considered necessary to help ensure U.S. leadership in 5G. The 3100-3550 MHz band is critical to Department of Defense (DoD) and Department of Homeland Security (DHS) radar operations for national defense and domestic security. DoD operates high-powered defense radar systems on fixed, mobile, shipborne, and airborne platforms throughout the band for air defense, missile and gunfire control, bomb scoring, battlefield weapon locations, air traffic control, and range safety. DHS operations are limited to fixed and transportable radars. In the aggregate and in some cases individually, the incumbent federal operations span the entire United States and Possessions. Some airborne systems operate nationwide; ground-based radars are located at more than one hundred unique locations; and shipborne radars operate in more than twenty ports, as well as along the Atlantic, Pacific, and Gulf coasts.

This report has two principal conclusions based on the assumption of no changes in incumbent operations and the legislative mandate to look at sharing. First, the 3450-3550 MHz portion of this band is a good candidate for potential spectrum sharing, including at the commercial system power levels sought by the wireless industry. Second, although ultimately some sharing of spectrum below 3450 MHz may be possible as well, additional analysis of the entire band should be conducted to assess the various sharing mechanisms and the potential for relocating incumbents from some portion of the remainder of the band for commercial use. Currently, there are both classified and unclassified federal operations below 3450 MHz, which could be problematic for sharing with a commercial wireless system. This would also need to be addressed, as well as the prospect that this portion of the frequency range may become even more congested if some federal operations are shifted down from above 3450 MHz to accommodate sharing at 3450-3550 MHz.

NTIA conducted the evaluation both as part of ongoing efforts to identify candidate bands for federal and non-federal sharing and in response to the MOBILE NOW Act. The analysis determined that the 3450-3550 MHz portion of the 3100-3550 MHz band has the highest probability of being able to accommodate sharing with commercial wireless services in a

relatively short timeframe. NTIA's initial determination was followed by a technical study of the 3450-3550 MHz sub-band conducted in collaboration with the Department of Defense (DoD), the exclusive federal user of the band.[1] The *3450-3550 MHz Technical Study* considered all federal systems in the band. It did not evaluate any existing non-federal systems.

The *3450-3550 MHz Technical Study* analyzed the potential aggregate interference to the incumbent federal operations from outdoor base stations, indoor access points, and mobile user equipment, using two different hypothetical commercial deployments. The analysis utilized industry-supplied commercial system characteristics. Each deployment scenario analyzed three sets of power levels, including both the relatively low-power operation currently permitted for commercial operations in the adjacent band above 3550 MHz and the higher power levels that industry representatives have indicated are optimal. The report was neutral as to whether the commercial systems would operate on a licensed or unlicensed basis and this distinction had no impact on the results. The report recognizes that as commercial deployment plans mature, it will be important to revise the models and update the analyses to take into account such developments as necessary. The report operated under the assumption the DoD would not make any operational changes to their current systems. As such, different DoD operating assumptions would have an impact on actual interference and thus the assessment of sharing.

Under these DoD operating assumptions, the technical report shows that interference from commercial operations would be expected throughout the band and in areas representing a large percentage of the U.S. population. It nonetheless concludes that, with a transition of nationwide aeronautical systems to alternative frequencies, proper interference mitigation mechanisms, and further study, spectrum sharing may be technically feasible for all or portions of the 3450-3550 MHz sub-band, including at all the power levels analyzed. The assessment identifies further work needed to reach a more definitive conclusion regarding the extent to which a sharing mechanism would enable assured access for uninterrupted federal missions while enabling commercial access.

As part of further work to determine how best to share the band, the technical report envisions a focus on three principal efforts: (i) a more in-depth assessment of the extent to which each federal system is used and the mission impact of introducing spectrum sharing, a process that is already underway; (ii) the development of a reliable mechanism for constraining nearby commercial operations when federal systems are operating, so that those nearby operations do not cause harmful interference; and (iii) consideration of relocating the nationwide aeronautical systems to alternative frequencies.

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[1] Edward Drocella, Robert Sole, Nickolas LaSorte, National Telecommunications and Information Administration, "Technical Feasibility of Sharing Federal Spectrum with Future Commercial Operations in the 3450-3550 MHz Band" Technical Rep. 20-546 (Jan. 27, 2020) ("*3450-3550 MHz Technical Study*"), *available at* https://www.ntia.doc.gov/report/2020/technical-feasibility-sharing-federal-spectrum-future-commercial-operations-3450-3550.

As a further effort, to facilitate potential sharing over the largest possible geographic area, NTIA recommends consideration of options for requiring commercial deployments to reduce out-of-band emissions and increase their resilience to such emissions from other systems. As well, consideration should be given to modifying incumbent operations in portions of the spectrum to facilitate sharing with commercial deployments and potentially relocating incumbents from portions of the spectrum to enable exclusive use by commercial services. DoD has a number of existing uses of this spectrum; potential changes to each will need to be evaluated on their own merits.

Next steps will focus on the further work needed to enable potential sharing of the 3450-3550 MHz portion of the band, where near-term success is most likely, and to consider possible ways to increase commercial access to more of the 3100-3550 MHz range.

BACKGROUND

Section 605(a) of the *Making Opportunities for Broadband Investment and Limiting Excessive and Needless Obstacles to Wireless* (MOBILE NOW Act) directs the Secretary of Commerce, in consultation with the Federal Communications Commission (FCC) and the head of each affected federal agency, working through NTIA, to submit a report evaluating "the feasibility of allowing commercial wireless services, licensed or unlicensed, to share use of the frequencies at 3100-3550 MHz" to the appropriate committees of Congress as well as the FCC.[2] Section 605(c) specifies that the report is to include an assessment of the possible impacts of sharing on federal and non-federal users already operating in the band; the criteria that may be necessary to ensure shared licensed or unlicensed services would not cause harmful interference to federal or non-federal users already operating in the band; and, if sharing is determined to be feasible, an identification of which of the frequencies are most suitable for sharing with commercial wireless services through the assignment of new licenses by competitive bidding, for sharing with unlicensed operations, or through a combination of licensing and unlicensed operations. Changes to incumbent operations to enable or facilitate potential sharing were not considered except for an isolated case of modifying frequency usage to relocate non-surveillance airborne operations.

In 2010, NTIA published its *Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband* (*Ten-Year Plan*).[3] The *Ten-Year Plan* identified 3100-3500 MHz among the initial candidate bands for potential repurposing in pursuit of the 500-megahertz goal. Concurrent with development of the *Ten-Year Plan*, NTIA conducted an assessment of accommodating wireless broadband systems in five frequency bands, including 3500-3650 MHz, to jump-start the process and recommend spectrum that could be made available in the short term.[4] In that evaluation, NTIA recommended that the upper 100 megahertz portion (3550-3650 MHz) of the 3500-3650 MHz band be made available for wireless broadband, for use outside of certain coastal and test and training areas.[5] That effort led to the establishment of the FCC's Citizens Broadband Radio Service (CBRS), which is currently being

[2] MOBILE NOW Act, Division P, Title VI of the Consolidated Appropriations Act of 2018, Pub. L. No. 115-141, 132 Stat. 348, 1100 (Mar. 23, 2018), *available at* https://www.congress.gov/115/plaws/publ141/PLAW-115publ141.pdf.

[3] NTIA, *Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband* (Oct. 2010) ("*Ten-Year Plan"*), *available at* http://www.ntia.doc.gov/files/ntia/publications/tenyearplan_11152010.pdf.

[4] NTIA, *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* (Oct. 2010), *available at* https://www.ntia.doc.gov/files/ntia/publications/fasttrackevaluation_11152010.pdf.

[5] *Id*. at v.

implemented.[6] The regulatory and technical rules for CBRS enable dynamic spectrum sharing among three tiers of federal and commercial users in the 3550-3700 MHz band with corresponding levels of rights to access the spectrum. The CBRS approach relies in part on software-based Spectrum Access Systems to notify and control commercial use when federal shipborne radars are operating nearby.[7]

NTIA then worked with the federal agencies to obtain spectrum usage information for their systems operating in five bands, including the 3100-3550 MHz band. NTIA also asked agencies to verify their system characteristics to enable calculation of the geographic coverage area of these systems and to provide estimates of their time of use. This data allowed for an overall approximation of the extent to which each system used its assigned spectrum. Based on this effort, in November 2016, NTIA published its *Quantitative Assessments of Spectrum Usage*[8] ("*QA Report"*), which concluded that potential opportunities for spectrum sharing existed in the 3505-3550 MHz band.[9]

Following release of the *QA Report,* NTIA included the 3100-3550 MHz band in an interagency assessment to prioritize and select the next federal band to be studied in detail for possible repurposing.[10] The assessment looked at several bands used by a number of different agencies. This initiative included the development of a strategic approach for identifying and prioritizing candidate bands for repurposing – one that would consider the costs of relocation, the availability of alternate spectrum with comparable technical characteristics, and factors such as band interdependencies and secondary effects. With these considerations and relying heavily on the data from the *QA Report,* NTIA, with advice from the Policy and Plans Steering Group (PPSG), selected the 3450-3550 MHz band for a detailed sharing feasibility study.[11] NTIA

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[6] *See, e.g. 3.5 GHz Band Overview, available at* https://www.fcc.gov/wireless/bureau-divisions/mobility-division/35-ghz-band/35-ghz-band-overview.

[7] *See* Letter from Paige R. Atkins, Assoc. Admin., Office of Spectrum Mgt., NTIA, to Julius P. Knapp, Chief, Office of Eng. and Tech., FCC (Mar. 24, 2015), *available at* http://www.ntia.doc.gov/files/ntia/publications/ntia_letter_docket_no_12-354.pdf

[8] NTIA, *Fourth Interim Progress Report on the Ten-Year Plan and Timetable and Plan for Quantitative* Assessments *of Spectrum Usage* at Appendix A, *Plan for Quantitative Assessments of Spectrum Usage* (June 2014), *available at* http://www.ntia.doc.gov/files/ntia/publications/fourth_interim_progress_report_final.pdf.

[9] United States Department of Commerce, *Quantitative Assessments of Spectrum Usage* (Nov. 2016), at 7, *available at* https://www.ntia.gov/files/ntia/publications/ntia_quant_assessment_report-no_appendices.pdf.

[10] This assessment was undertaken in conjunction with the Policy and Plans Steering Group (PPSG), an inter-agency body of senior, political-level Federal officials that advise the NTIA Administrator on spectrum policy and strategic plans.

[11] David J. Redl, Assistant Secretary for Communications and Information and NTIA Administrator, *NTIA Identifies 3450-3550 MHz for Study as Potential Band for Wireless Broadband Use*, NTIA Blog, Feb. 26, 2018, *available at* https://www.ntia.doc.gov/blog/2018/ntia-identifies-3450-3550-mhz-study-potential-band-wireless-broadband-use. ("NTIA, in coordination with the Department of Defense (DoD) and other federal agencies, has identified 100 megahertz of spectrum for potential repurposing to spur commercial wireless innovation. This spectrum, the 3450-

convened a joint working group with DoD (the exclusive federal user in the 3450-3550 MHz band) and the FCC to undertake these efforts that culminated in the *3450-3550 MHz Technical Study*.

OPERATIONS IN THE 3100-3550 MHz BAND

Segments of the 3100-3550 MHz band are allocated in the United States for federal radiolocation and ground-based radionavigation services on a primary basis as shown in Table 1 below. Segments are also allocated for the federal and non-federal Earth exploration-satellite and space research services using active sensors, on a secondary basis, and for the non-federal radiolocation and amateur services, also on a secondary basis.[12] A summary of allocations for the 3100-3300 MHz, 3300-3500 MHz, and 3500-3550 MHz bands contained in the U.S. National Table of Frequency Allocations is provided in Table 1.

TABLE 1—Excerpt from the U.S. National Table of Frequency Allocations

Frequency Band	Federal Usage	Non-Federal Usage
3100-3300 MHz	RADIOLOCATION Earth exploration-satellite (active) Space research (active) **G59** (all Federal non-military radiolocation shall be secondary to military radiolocation) Earth exploration-satellite (active) Space research (active) **US342** (all practicable steps shall be taken to protect the radio astronomy service from harmful interference).	Earth exploration-satellite (active) Space research (active) Radiolocation **US342** (all practicable steps shall be taken to protect the radio astronomy service from harmful interference).
3300-3500 MHz	RADIOLOCATION **US108** (low-power survey operations secondary to other Federal radiolocation operations) **G2** (use of the Federal radiolocation service is restricted to the military services)	Amateur Radiolocation **5.282** (amateur-satellite service on a non-interference basis) **US108** (low-power survey operations secondary to Federal radiolocation operations)

3550 MHz band, is in the mid-frequency range and could be a key asset in our nation's broadband spectrum inventory.").

[12] Federal Communications Commission, Office of Engineering and Technology, Policy and Rules Division, *FCC Online Table of Frequency Allocations*, 47 C.F.R. § 2.106 at 40-41(Revised March 6, 2020), *available at* https://transition.fcc.gov/oet/spectrum/table/fcctable.pdf (*Allocation Table*). This online *Allocation Table* provides the full text of the applicable footnotes, some of which have been abbreviated in Table 1. Stations of a secondary service shall not cause harmful interference to stations of primary services to which frequencies are already assigned or to which frequencies may be assigned at a later date, and cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or may be assigned at a later date, ITU, *Radio Regulations*, Vol I–Articles (Edition of 2016), at 40 (Footnotes 5.28 through 5.30), *available at* https://www.itu.int/pub/R-REG-RR/en.

3500-3550 MHz	RADIOLOCATION **G59** (all Federal non-military radiolocation shall be secondary to military radiolocation) AERONAUTICAL RADIONAVIGATION (ground-based) **G110** (Federal ground-based stations in the aeronautical radionavigation service may be authorized between 3500-3650 MHz when accommodation in the band 2700-2900 MHz is not technically and/or economically feasible)	Radiolocation
Note: A radio service in capital letters indicates a primary allocation, while regular case indicates a secondary allocation. Bold alphanumerics represent U.S. or Government (G) footnotes that further define authorized use of the bands.		

Federal Systems

The 3100-3550 MHz band is critical to DoD and DHS radar operations for national defense and domestic security. DoD operates high-power defense radar systems on fixed, mobile, shipborne, and airborne platforms in this band. DoD operates radar systems used for air defense, missile and gunfire control, bomb scoring, battlefield weapon locations, air traffic control, and range safety. DHS operates fixed and transportable radars in the band to track unmanned aeronautical vehicles. The incumbent federal operations span the entire United States and Possessions (*i.e.*, some airborne systems operate nationwide, ground-based radars are located at more than one hundred unique locations, and shipborne radars operate in more than twenty ports, as well as along the Atlantic, Pacific, and Gulf coasts). Below is a summary of federal systems operating in the band.

Airborne Radar Systems

The Air Force employs a high-power airborne radar that operates nationwide. This radar performs critical airborne early warning and control functions. The Air Force also employs two Station Keeping Equipment (SKE) systems to enhance flight safety and facilitate the management of cargo multi-ship formations. SKE is installed on cargo aircraft and formations can range in size from a single two-aircraft element to multi-element formations. The operator selects the desired formation position prior to takeoff and the SKE system uses pulsed signals to maintain that position. The Air Force currently operates SKE from numerous active and reserve bases throughout the Continental United States, as well as Alaska and Hawaii. The SKE systems are authorized to operate nationwide.. The Naval Air Systems Command also operates airborne systems on ranges at Point Mugu and China Lake, CA; Patuxent River, MD; and Pacific Missile Range Facility, Barking Sands, HI.

Ground-based Radar Systems

DoD has four transportable ground-based radar systems operating in this band. DHS has one such system. The Army, Marine Corps, and DHS operate at many locations within the United States, and the Naval Air Systems Command operates ground-based radar systems at their ranges.

Shipborne Radar Systems

The Navy uses this band for a number of radionavigation purposes, including air operations, air traffic control (ATC), and approach control. The Navy operates marshalling ATC radar systems on all aircraft carriers and amphibious assault ships for vectoring aircraft into final approach. This system also serves as a backup short-range, air-search radar system. Shipborne radars can radiate at all major Navy ports, shipyards, and some commercial ports. It is normal practice for the Navy to operate shipborne radars at least 10 km from the coast to reduce potential electromagnetic interference impacts near shore and ports.

Other Potential Federal Systems

In accordance with footnote US342 of the U.S. Table of Frequency Allocations, radio astronomy is authorized to use the bands 3260-3267 MHz, 3332-3339 MHz, and 3345.8-3352.5 MHz for spectral line observations, and all practicable steps are required to be taken to protect those operations from harmful interference. The 3100-3300 MHz portion of the band also has secondary allocations for federal Earth exploration-satellite (active) and space research (active) services. As such, the band can be used for multi-spectral imaging of Earth by spaceborne active microwave sensors, such as synthetic aperture radars. Currently, however, based on the thorough interagency process that NTIA conducted, no federal systems of concern are operating in the Earth exploration-satellite (active) and space research (active) services in the 3100-3300 MHz portion of the band. NASA has an experimental frequency assignment at 3200 MHz for the NISAR S-band synthetic aperture radar (SAR) being developed by the Indian Space Research Organization. Using advanced radar imaging that will provide an unprecedented, detailed view of Earth, the satellite is designed to observe and take measurements of some of the planet's most complex processes. These include ecosystem disturbances, ice-sheet collapse, and natural hazards such as earthquakes, tsunamis, volcanoes and landslides.[13]

Non-federal Systems

Non-federal operations include radiolocation services allocated on a secondary basis throughout the 3100-3550 MHz range. Additional non-federal usage includes the Earth exploration-satellite (active) and Space research (active) services on a secondary basis. The

[13] Additional information is available at https://www.jpl.nasa.gov/missions/nasa-isro-synthetic-aperture-radar-nisar/.

secondary status means that these stations are not permitted to either cause harmful interference to, or claim protection from, stations of primary services. The FCC has initiated a rulemaking proceeding to address non-federal operations in this band. In a recent Notice of Proposed Rulemaking, the FCC proposed to remove the existing non-federal radiolocation and amateur allocations in the 3.3-3.55 GHz band and relocate incumbent non-federal operations out of the band.[14] The FCC also sought comment on relocation options and transition mechanisms for non-federal operations. Because secondary non-federal operations do not raise significant concerns in terms of protecting federal operations, and the FCC has initiated procedures to address them, secondary non-federal operations were not studied for this report.

SHARING FEASIBILITY ASSESSMENT

As discussed above, NTIA, with advice from the PPSG, determined that a near-term focus on the 3450-3550 MHz band would be the most productive path toward identifying the next spectrum sharing opportunities. NTIA published its *3450-3550 MHz Technical Study* in January 2020.[15] The report concludes that, with a transition of nationwide aeronautical systems to alternative frequencies, spectrum sharing should be technically feasible and may be commercially attractive for the entire 3450-3550 MHz band, including at all the power levels analyzed. If a dynamic, time-based sharing mechanism were implemented, commercial operations would be contingent on spectrum availability, which will depend on the frequency, time, and location of federal system operations. Further work would be required – both to determine the extent to which actual usage by federal systems leaves sufficient time for commercial operations to be economically feasible, and to develop reliable time-based sharing mechanisms to protect federal systems when they do operate. Without modifications to DoD operations, the analysis indicates that alternative approaches to sharing would be unproductive because the incumbent federal systems operate across the entire band and in or near populated areas, making static frequency-based and geographic-based sharing approaches of minimal practical value even at the lower power levels unless combined with an effective time-based sharing approach that can expand the frequencies and areas available for commercial operations.

[14] *Notice of Proposed Rulemaking* in WT Docket No. 19-348 (Dec. 16, 2019).

[15] *Supra,* n.1.

THE WAY FORWARD

NTIA recommends moving forward with a focus on four principal efforts for the full 3100-3550 MHz band: (i) a more in-depth assessment of the extent each of the federal systems is used; (ii) the development of a reliable mechanism for commercial operations to coordinate when federal systems are operating; (iii) assessment of the potential for relocating federal systems, such as nationwide airborne systems; and (iv) consideration of improved out-of-band emission limits for future commercial operations in the band.[16] One of the vehicles that should address some of these issues is a planned DoD study pursuant to the Spectrum Pipeline Act.[17] These recommendations are discussed further below.

A further assessment of the actual federal use is required and is already underway for some of the systems in the band, pursuant to the implementation of a 2018 Presidential Memorandum.[18] In addition to verifying federal use of the band, it is also important to obtain updated information from the commercial wireless industry as their deployment plans evolve.

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[16] The first three recommendations are also included in the *3450-3550 Technical Study*.

[17] Spectrum Pipeline Act of 2015, Public Law No. 114-74, § 1005, 129 Stat. 621 (2015).

[18] Memorandum for the Heads of Executive departments and Agencies, Developing a Sustainable Spectrum Strategy for America's Future, 83 Fed. Reg. 54513 (Oct. 30, 2018), at Sec. 2(a), *available at* https://www.gpo.gov/fdsys/pkg/FR-2018-10-30/pdf/2018-23839.pdf. In response to the Presidential Memorandum, NTIA established a process for agencies to review their current data and provide additional information, support, and assistance regarding their assignments and usage of spectrum and identified the 3100-3550 MHz band for the initial effort. Memorandum To: Executive Branch Departments and Agencies, From: Diane Rinaldo, Assistant Secretary of Commerce for Communications and Information (Acting), Subject: Review of Current Frequency Assignments and Quantification of Spectrum Usage (Aug. 1, 2019).

Further guidance is provided by two statutory provisions. 47 U.S.C. Section 923(j)(1) provides:

> In evaluating a band of frequencies for possible reallocation for exclusive non-Federal use or shared use, the NTIA shall give priority to options involving reallocation of the band for exclusive non-Federal use and shall choose options involving shared use only when it determines, in consultation with the Director of the Office of Management and Budget, that relocation of a Federal entity from the band is not feasible because of technical or cost constraints.

Pub. L. 106–65, div. A, title X, §1062(b), Oct. 5, 1999, 113 Stat. 768, provides:

> (b) SURRENDER OF DEPARTMENT OF DEFENSE SPECTRUM.— (1) IN GENERAL.—If, in order to make available for other use a band of frequencies of which it is a primary user, the Department of Defense is required to surrender use of such band of frequencies, the Department shall not surrender use of such band of frequencies until—
>
> > (A) the National Telecommunications and Information Administration, in consultation with the Federal Communications Commission, identifies and makes available to the Department for its primary use, if necessary, an alternative band or bands of frequencies as a replacement for the band to be so surrendered; and
>
> (B) the Secretary of Commerce, the Secretary of Defense, and the Chairman of the Joint Chiefs of Staff jointly certify to the Committee on Armed Services and the Committee on Commerce, Science, and Transportation of the Senate, and the Committee on Armed Services and the Committee on Commerce of the House of Representatives, that such alternative band or bands provides comparable technical characteristics to restore essential military capability that will be lost as a result of the band of frequencies to be so surrendered.

This information will allow for a more complete and informed analysis of all potential options for allowing commercial operations in the band.

While the work that has been done for CBRS in the adjacent 3550-3700 MHz band is directly applicable to the establishment of sharing between commercial wireless and shipborne radars in this band, it is less relevant to the development of appropriate systems to protect the other – ground-based and airborne – systems in the band. This is partly because industry-managed monitoring stations outside military installations are inherently problematic from an operational security perspective and many more would be required due to the large number of ground-based radar sites, and partly because there are unique technical challenges to monitoring airborne operations.

Among the options being considered, NTIA will examine the development on an automated, real-time, incumbent-informing spectrum sharing system ("incumbent-informing system") that NTIA would operate in conjunction with DoD to notify commercial entities when the latter would need to cease operations. NTIA notes that in the *3450-3550 MHz Technical Study,* NTIA recommended further consideration of options for shifting certain nationwide airborne systems to other frequencies in order to permit commercial operations at full power. Accordingly, while the envisioned incumbent-informing system is being developed and deployed, and assuming a sensing-based system is available to protect shipborne radars and that the nationwide airborne systems can relocate from the band, it is possible that commercial operations could commence subject to protection areas around the ground-based radar sites and those of the few local airborne systems.

Finally, to better facilitate federal and non-federal operations on adjacent frequencies, NTIA recommends that the FCC give serious consideration to setting tighter limits on out-of-band emissions of commercial operations. It is likely that all parties would benefit from tighter limits with commercial systems operating more often and closer to federal systems, users having more capacity, government systems being better protected, and auction revenue potentially increasing. Without tighter limits applicable to all commercial systems, the manufacturers and operators of commercial equipment might not optimize its use for spectrum efficient operations.

While NTIA's priority has been enabling spectrum sharing in the 3450-3550 MHz portion of the 3100-3550 MHz band, consistent with the Administration guidance, NTIA is considering other options for the 3100-3550 MHz band. For instance, NTIA is working with the departments and agencies that operate systems on these frequencies to determine if, when and where and at what cost incumbents can relocate from spectrum in this band. As noted above, the lower portion of the band is more congested and includes additional systems that have not been analyzed. However, just as development of the CBRS band is providing important lessons that will facilitate the development of sharing in the 3450-3550 MHz band, the work done for 3450-3550 MHz may influence efforts to develop clearing in portions of the band or sharing across the band. Additionally, DoD is in the midst of efforts to partner with the commercial industry to

further explore dynamic spectrum sharing technologies that could be used in this band.[19] DoD has a number of existing uses of this spectrum; potential changes to each will need to be evaluated on their own merits. Consideration should be given to modifying incumbent spectrum use by adjusting missions, concept of operations, training, and testing as required to facilitate as near-exclusive use as possible by commercial services in portions of the band.

[19] *See, e.g.,* Department of Defense, Release, DOD Issues Special Notice Seeking Input From Industry on 5G Technology Development (Dec. 2, 2019), *available at* https://www.defense.gov/Newsroom/Releases/Release/Article/2029707/dod-issues-special-notice-seeking-input-from-industry-on-5g-technology-developm/; Department of Defense, Intent to Announce - Request for Prototype Proposals (RPPs) for Smart Warehouse and Asset Management and 5G Dynamic Spectrum Sharing (DSS) (Nov. 29, 2019), *available at* https://beta.sam.gov/opp/c1cd8b22a5d945bba5dd5e083776139f/view.

Appendix: Text of Section 605 of the *MOBILE NOW Act*

SEC. 605. 3 GIGAHERTZ SPECTRUM.

(a) BETWEEN 3100 MEGAHERTZ AND 3550 MEGAHERTZ.—Not later than 24 months after the date of enactment of this Act, and in consultation with the Commission and the head of each affected Federal agency (or a designee thereof), the Secretary, working through the NTIA, shall submit to the Commission and the appropriate committees of Congress a report evaluating the feasibility of allowing commercial wireless services, licensed or unlicensed, to share use of the frequencies between 3100 megahertz and 3550 megahertz.

(b) BETWEEN 3700 MEGAHERTZ AND 4200 MEGAHERTZ.—Not later than 18 months after the date of enactment of this Act, after notice and an opportunity for public comment, and in consultation with the Secretary, working through the NTIA, and the head of each affected Federal agency (or a designee thereof), the Commission shall submit to the Secretary and the appropriate committees of Congress a report evaluating the feasibility of allowing commercial wireless services, licensed or unlicensed, to use or share use of the frequencies between 3700 megahertz and 4200 megahertz.

(c) REQUIREMENTS.—A report under subsection (a) or (b) shall include the following:

> (1) An assessment of the operations of Federal entities that operate Federal Government stations authorized to use the frequencies described in that subsection.
>
> (2) An assessment of the possible impacts of such sharing on Federal and non-Federal users already operating on the frequencies described in that subsection.
>
> (3) The criteria that may be necessary to ensure shared licensed or unlicensed services would not cause harmful interference to Federal or non-Federal users already operating in the frequencies described in that subsection.
>
> (4) If such sharing is feasible, an identification of which of the frequencies described in that subsection are most suitable for sharing with commercial wireless services through the assignment of new licenses by competitive bidding, for sharing with unlicensed operations, or through a combination of licensing and unlicensed operations.

(d) COMMISSION ACTION.—The Commission, in consultation with the NTIA, shall seek public comment on the reports required under subsections (a) and (b), including regarding the bands identified in such report as feasible pursuant to subsection (c)(4).