

# **Second Annual Report on the Status of Spectrum Repurposing**



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## EXECUTIVE SUMMARY

The United States continues to build on its 5G leadership and is critically focused on repurposing radiofrequency spectrum – especially through investment in America’s mid-band spectrum. Our country leads the world in availability of high- and low-band spectrum for commercial wireless services. Now, as this Report highlights, the United States is making tremendous strides in repurposing important mid-band spectrum. The 2018 *Presidential Memorandum “Developing a Sustainable Spectrum Strategy for America’s Future”*<sup>1</sup> required the Secretary of Commerce to report annually on efforts to repurpose spectrum – either on an exclusive or shared basis – to support commercial wireless services.<sup>2</sup> This is the second such report, and it highlights spectrum repurposing activities through August 30, 2020 that are meeting statutory requirements and advancing President Trump’s policy objectives.

The United States is making considerable progress in repurposing spectrum for commercial wireless services – particularly mid-band spectrum (*i.e.*, 1 GHz to 10 GHz), which is crucial to U.S. leadership in the “race to 5G.”<sup>3</sup> These accomplishments significantly increase the amount of mid-band spectrum made available to facilitate and augment 5G, which now totals 1130.5 megahertz with the inclusion of the 100 megahertz being made available at 3450-3550 MHz, the completion of the Federal Communications Commission’s (FCC’s) “C-band” rulemaking, and the execution of the CBRS auction.<sup>4</sup> The National Telecommunications and

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<sup>1</sup> *Developing a Sustainable Spectrum Strategy for America’s Future*, Memorandum for the Heads of Executive Departments and Agencies (rel. Oct. 25, 2018), *published at* 83 Fed. Reg. 54513 (Oct. 30, 2018), <https://www.whitehouse.gov/presidential-actions/presidential-memorandum-developing-sustainable-spectrum-strategy-americas-future/> (“*Presidential Memorandum*”), at Section 1.

<sup>2</sup> In the context of this report, “spectrum repurposing” means changing the allocation of specific frequencies from one radiofrequency service or set of services to another, or changing the service rules associated with an allocation, such that the frequencies can be used by different entities and in different ways than previously. The repurposed spectrum may be allocated for either federal or non-federal use, or both, and the repurposing may involve relocating legacy systems to other spectrum bands, requiring legacy and new systems to share spectrum, or, in rare cases, discontinuing legacy systems altogether.

<sup>3</sup> For purposes of this report, low-band is below 1 GHz, mid-band is 1-10 GHz, and high-band is above 10 GHz, which provides for ease of reference, particularly in light of various demarcations in use from time to time by governments, service providers, and manufacturers. *See, e.g.*, Defense Innovation Board Report, *The 5G Ecosystem: Risks & Opportunities for DoD* (Apr. 3, 2019), [https://media.defense.gov/2019/Apr/04/2002109654/-1/-1/0/DIB\\_5G\\_STUDY\\_04.04.19.PDF](https://media.defense.gov/2019/Apr/04/2002109654/-1/-1/0/DIB_5G_STUDY_04.04.19.PDF); White House Office of Science and Technology Policy (OSTP) Report, *Emerging Technologies and Their Expected Impact on Non-Federal Spectrum Demand* (May 2019), <https://www.whitehouse.gov/wp-content/uploads/2019/05/Emerging-Technologies-and-Impact-on-Non-Federal-Spectrum-Demand-Report-May-2019.pdf>.

<sup>4</sup> *See, e.g.*, The White House, *Fact Sheet: President Donald J. Trump is Unleashing America’s 5G Potential* (Aug. 10, 2020), <https://www.whitehouse.gov/briefings-statements/president-donald-j-trump-unleashing-americas-5g-potential/>. *See also* *Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, GN Docket No. 18-122, Report and Order and Order of Proposed Modification, 35 FCC Rcd 2343 (rel. Mar. 3, 2020), *available at* <https://docs.fcc.gov/public/attachments/FCC-20-22A1.pdf>; *Auction of Priority Access Licenses for the 3550-3650*

Information Administration (NTIA) continues to study additional federal bands (e.g., 3100-3450 MHz and 1300-1350 MHz), the FCC has active proceedings that would make more mid-band spectrum commercially available, and mid-band spectrum repurposing will be a main focus of the World Radiocommunication Conference (WRC) scheduled for 2023.

Importantly, the repurposing efforts described herein – for all spectrum bands, not just mid-band – could not have been accomplished without the tremendous and cooperative work of numerous federal agencies, including the FCC. Often, repurposing requires significant effort to replace or modify sophisticated equipment, to find suitable bands for relocation, and to coordinate with new commercial entrants – all while federal agencies carry out their primary, and typically critical, missions.

The table below provides a summary description of the status of current spectrum repurposing efforts of NTIA and the FCC, band by band. Bands shaded in green represent substantially completed repurposing activities. Bands shaded in yellow represent repurposing activities that are still ongoing.<sup>5</sup>

**TABLE 1**

| <i>Frequency Band</i> | <i>Repurposing Status – Through August 30, 2020</i>  |
|-----------------------|--|
| <b>MHz</b>            | <b>LOW-BAND</b>  |
| 512-698               | The FCC repurposed this band from television broadcasting; the broadcast station DTV transition is nearing completion, and wireless services have commenced in some markets.   |
| 809-817;<br>854-862   | The FCC’s <i>800 MHz Rebanding Streamlining Order</i> <sup>6</sup> became effective on December 16, 2019 and required licensees that had completed reconfiguration of their systems to provide notice of any unresolved dispute by January 15, 2020. |
| 896-901;<br>935-940   | In May 2020, the FCC released an Order reconfiguring the 900 MHz band to facilitate the development of broadband technologies and services, including for critical infrastructure.   |

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*MHz Band – Comment Sought on Competitive Bidding Procedures for Auction 105*, AU Docket No. 19-244, Public Notice, 34 FCC Rcd 9215 (Sept. 27, 2019), available at <https://docs.fcc.gov/public/attachments/FCC-19-96A1.pdf>.

<sup>5</sup> Dep’t of Commerce and NTIA, *Annual Report on the Status of Spectrum Repurposing* (Aug. 2019), available at [https://www.ntia.doc.gov/files/ntia/publications/spectrum\\_repurposing\\_report\\_august\\_2019.pdf](https://www.ntia.doc.gov/files/ntia/publications/spectrum_repurposing_report_august_2019.pdf) (“*First Annual Report*”).

<sup>6</sup> *Improving Public Safety Communications in the 800 MHz Band*, WT Docket No. 02-55, Order and Sixth Further Notice of Proposed Rulemaking, 34 FCC Rcd 10208 (rel. Oct. 28, 2019) (“*800 MHz Rebanding Streamlining Order*”), available at <https://docs.fcc.gov/public/attachments/FCC-19-108A1.pdf>.

| <b>Frequency Band</b>                         | <b>Repurposing Status – Through August 30, 2020</b>   |
|---|---|
| <b>MHz</b>                                    | <b>MID-BAND</b>   |
| 1300-1350                                     | Currently used primarily for federal radars, with some minimal non-federal radar use, this band is under study by the Federal Aviation Administration (FAA), Department of Defense (DoD), and Department of Homeland Security (DHS) for sharing with wireless services, with the goal of freeing-up at least 30 megahertz.  |
| 1526-1536;<br>1627.5-1637.5;<br>1646.5-1656.5 | These three sub-bands are within the 1525-1559 MHz and 1626.5-1660 MHz bands allocated for federal and non-federal mobile satellite services (including an ancillary terrestrial component (ATC)). Ligado has received approval with conditions for terrestrial operations in these bands.  |
| 1675-1680                                     | This band is under study by the National Oceanic and Atmospheric Administration (NOAA) and is the subject of an FCC rulemaking proceeding <sup>7</sup> to determine if the band could be shared with commercial terrestrial wireless services. Results from the NOAA study, completed in 2020, are being prepared for final release.  |
| 1695-1710;<br>1755-1780;<br>2155-2180         | The FCC auctioned these “AWS-3” bands (65 megahertz) in 2015 to accommodate licensed wireless services, with some continued federal sharing at selected locations. The transition is largely done and is to be completed by 2025.   |
| 2483.5-2495                                   | These frequencies are licensed to Globalstar—the FCC provided regulatory relief for a Terrestrial Low Power Service adjacent to the primary Wi-Fi band.   |
| 2496-2690                                     | The FCC adopted rules to provide greater flexibility for current Educational Broadband Service (EBS) licensees and to create new opportunities for additional entities to obtain unused spectrum. The FCC’s Public Notice, <sup>8</sup> released in January 2020, set a Tribal Priority Opportunity window, with the remaining spectrum licenses to be made available through a competitive bidding process. <sup>9</sup> |

<sup>7</sup> The FCC NPRM proposes a reallocation to non-federal flexible wireless use. *See Allocation and Service Rules for the 1675-1680 MHz Band*, WT Docket No. 19-116, Notice of Proposed Rulemaking and Order, 34 FCC Rcd 3552, 3553 (rel. May 13, 2019), available at <https://ecfsapi.fcc.gov/file/05132467403342/FCC-19-43A1.pdf>.

<sup>8</sup> *Wireless Telecommunications Bureau Announces Procedures for 2.5 GHz Rural Tribal Priority Window*, WT Docket No. 18-120, Public Notice, DA 20-18 (Jan. 6, 2020), available at <https://ecfsapi.fcc.gov/file/01062185814033/DA-20-18A1.pdf>.

<sup>9</sup> *Transforming the 2.5 GHz Band*, WT Docket. No. 18-120, Report and Order, 34 FCC Rcd 5446 (July 11, 2019), available at <https://ecfsapi.fcc.gov/file/0711901905298/FCC-19-62A1.pdf>; *Transforming the 2.5 GHz Band*, WT Docket. No. 18-120, Memorandum Opinion and Order, DA 20-819 (WTB rel. July 31, 2019), available at <https://docs.fcc.gov/public/attachments/DA-20-819A1.pdf>.

| <b>Frequency Band</b> | <b>Repurposing Status – Through August 30, 2020</b>   |
|-----------------------|---|
| 3100-3550             | The White House announced in August 2020 that the 3450-3550 MHz band would be auctioned for commercial wireless services including 5G. This followed NTIA’s technical report in January 2020 identifying the feasibility of repurposing the band. <sup>10</sup> In August 2020 the FCC announced its intent to move quickly to adopt service rules for the 3.45 GHz band and to hold an auction to bring this spectrum to market. The FCC earlier had issued a Notice of Proposed Rulemaking (NPRM) proposing to remove non-federal secondary radiolocation and amateur allocations in the 3300-3550 MHz band and prepare it for possible commercial wireless use consistent with the MOBILE NOW Act. <sup>11</sup> |
| 3550-3700             | An auction of Priority Access Licenses in the Citizens Broadband Radio Service concluded on August 25, 2020. <sup>12</sup> The FCC has authorized five SAS Administrators to facilitate commercial use of the spectrum. <sup>13</sup>   |

<sup>10</sup> Edward Drocella, Robert Sole & Nickolas LaSorte, NTIA Office of Spectrum Management, *NTIA Technical Report 20-546: Technical Feasibility of Sharing Federal Spectrum with Future Commercial Operations in the 3450-3550 MHz Band* (Jan. 27, 2020), available at <https://www.ntia.gov/report/2020/technical-feasibility-sharing-federal-spectrum-future-commercial-operations-3450-3550> (“NTIA 3450-3550 MHz Technical Feasibility Report”).

<sup>11</sup> *Facilitating Shared Use in the 3.1-3.55 GHz Band*, WT Docket No. 19-348, Notice of Proposed Rulemaking, 34 FCC Rcd 12662 (rel. Dec. 16, 2019), available at <https://ecfsapi.fcc.gov/file/121661888341/FCC-19-130A1.pdf>.

<sup>12</sup> *Auction of Priority Access Licenses for the 3550-3650 MHz Band*, AU Docket No. 19-244, Public Notice, 35 FCC Rcd 2140 (Mar. 2, 2020), available at <https://docs.fcc.gov/public/attachments/FCC-20-18A1.pdf>; *Auction of Priority Access Licenses for the 3550-3650 MHz Band Rescheduled to Begin July 23, 2020*, AU Docket No. 19-244, Public Notice, DA 20-330 (WTB Mar. 25, 2020), available at <https://docs.fcc.gov/public/attachments/DA-20-330A1.pdf>; FCC News, *FCC Starts First 5G Mid-Band Spectrum Auction Today* (July 23, 2020), <https://docs.fcc.gov/public/attachments/DOC-365702A1.pdf>; *Auction of Priority Access Licenses in the 3550-3650 MHz Band Closes*, AU Docket No. 19-244, Public Notice, DA 20-1009 (WTB/OEA Sept. 2, 2020), available at <https://docs.fcc.gov/public/attachments/DA-20-1009A1.pdf>.

<sup>13</sup> *Wireless Telecommunications Bureau and Office of Engineering and Technology Approve Four Spectrum Access System Administrators for Full Scale Commercial Deployment in the 3.5 GHz Band and Emphasize Licensee Compliance Obligations in the 3650-3700 MHz Band Under Part 96*, GN Docket No. 15-319, Public Notice, 35 FCC Rcd 117 (WTB/OET Jan. 27, 2020), available at <https://ecfsapi.fcc.gov/file/0127193875857/DA-20-110A1.pdf>; *Wireless Telecommunications Bureau and Office of Engineering and Technology Approve Spectrum Access System Administrator Amdocs for Full Scale Commercial Deployment in the 3.5 GHz Band*, GN Docket No. 15-319, Public Notice, 35 FCC Rcd 3687, DA 20-437 (WTB/OET Apr. 21, 2020), available at <https://docs.fcc.gov/public/attachments/DA-20-437A1.pdf>.

| <b>Frequency Band</b> | <b>Repurposing Status – Through August 30, 2020</b>  |
|-----------------------|--|
| 3700-3980             | The FCC is making 280 megahertz of C-band satellite spectrum available for public auction to support licensed commercial wireless services. <sup>14</sup> WRC-19 put into consideration identification of the frequency band 3.6-3.8 GHz for IMT/5G on the agenda for the next Conference in 2023. <sup>15</sup>                                 |
| 4940-4990             | The FCC continues to explore ways to increase commercial investment in and the use of the 4.9 GHz band. <sup>16</sup>  |
| 5850-5925             | On December 12, 2019, the FCC proposed rule changes that would designate the lower 45 megahertz of the band for unlicensed use, which can include Wi-Fi, and the upper 30 megahertz for Cellular Vehicle to Everything (C-V2X) and/or Dedicated Short Range Communications (DSRC) intelligent transportation systems technologies. <sup>17</sup> |
| 5925-7125             | The FCC issued a Report and Order authorizing these bands for Wi-Fi and a Further Notice of Proposed Rulemaking that would permit Very Low Power unlicensed operations. <sup>18</sup>  |

<sup>14</sup> *Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, GN Docket No. 18-122, Report and Order and Order of Proposed Modification, 35 FCC Rcd 2343 (rel. Mar. 3, 2020), available at <https://docs.fcc.gov/public/attachments/FCC-20-22A1.pdf>; *Auction of Flexible-Use Service Licenses in the 3.7-3.98 GHz Band for Next Generation Wireless Services*, AU Docket No. 20-25, Public Notice, FCC 20-110 (Aug. 7, 2020), available at <https://docs.fcc.gov/public/attachments/FCC-20-110A1.pdf>.

<sup>15</sup> See Final Acts of the World Radiocommunication Conference 2019 (WRC-19), Resolution 811 at p. 541, available at [https://www.itu.int/dms\\_pub/itu-r/opb/act/R-ACT-WRC.14-2019-PDF-E.pdf](https://www.itu.int/dms_pub/itu-r/opb/act/R-ACT-WRC.14-2019-PDF-E.pdf). The International Telecommunications Union (ITU) uses the terminology International Mobile Telecommunications (IMT) for commercial wireless services with IMT-2020 representing 5G capabilities. For purposes of this report, 5G is synonymous with IMT-2020. An *identification* of spectrum is an international concept that provides guidance to countries internationally on a specific spectrum allocation that may be used by a large number of countries for a specified use.

<sup>16</sup> See, e.g., *Amendment of Part 90 of the Commission's Rules*, WP Docket No. 07-100, Sixth Further Notice of Proposed Rulemaking, 33 FCC Rcd 3261 (rel. Mar. 23, 2018), available at <https://ecfsapi.fcc.gov/file/03231913715191/FCC-18-33A1.pdf>.

<sup>17</sup> *Use of the 5.850-5.925 GHz Band*, ET Docket No. 19-138, Notice of Proposed Rulemaking, 34 FCC Rcd 12603 (rel. Dec. 17, 2019), available at <https://ecfsapi.fcc.gov/file/1217200308588/FCC-19-129A1.pdf>.

<sup>18</sup> *Unlicensed Use of the 6 GHz Band*, ET Docket No. 18-295, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 3852, FCC 20-51 (rel. Apr. 24, 2020), available at <https://docs.fcc.gov/public/attachments/FCC-20-51A1.pdf>.



| <b>Frequency Band</b>               | <b>Repurposing Status – Through August 30, 2020</b>  |
|-------------------------------------|--|
| <b>GHZ</b>                          | <b>HIGH BAND</b>   |
| 24.25-24.45;<br>24.75-25.25         | The FCC made 700 megahertz of spectrum available in the 24 GHz band under flexible-use rules and completed an auction of licenses in this band. <sup>19</sup> WRC-19 identified these bands for 5G. <sup>20</sup>  |
| 27.5-28.35                          | The FCC made 850 megahertz of spectrum available in the 28 GHz band under flexible-use rules and completed an auction of 28 GHz licenses. <sup>21</sup>  |
| 25.25-27.5                          | The FCC sought comment on potential shared use of the 26 GHz band. <sup>22</sup> WRC-19 identified this band for 5G. <sup>23</sup>   |
| 37-37.6                             | The FCC sought comment on a mechanism for shared use of the Lower 37 GHz band by federal and non-federal entities. <sup>24</sup> WRC-19 identified the 37-43.5 GHz band for 5G. <sup>25</sup>  |
| 37.6-38.6;<br>38.6-40;<br>47.2-48.2 | The FCC made 3.4 gigahertz of spectrum available in the Upper 37 GHz, 39 GHz, and 47 GHz bands, and it completed an incentive auction to assign new licenses for contiguous spectrum in these bands while preserving incumbents' existing spectrum usage rights in the 39 GHz band. <sup>26</sup> WRC-19 identified several of these bands for 5G. <sup>27</sup> |

<sup>19</sup> *Auction of 24 GHz Upper Microwave Flexible Use Service Licenses Closes*, AU Docket No. 18-85, Public Notice, 34 FCC Rcd 4294 (OEA/WTB June 3, 2019), available at <https://docs.fcc.gov/public/attachments/DA-19-485A1.pdf>.

<sup>20</sup> See Final Acts WRC-19, Resolution 242 at p. 351.

<sup>21</sup> *Auctions of 28 GHz Upper Microwave Flexible Use Licenses for Next-Generation Wireless Services Closes; Gross Winning Bid Amounts Announced for Auction 101*, AU Docket No. 18-85, Public Notice, 34 FCC Rcd 75 (Jan. 31, 2019), available at <https://docs.fcc.gov/public/attachments/DA-19-23A1.pdf>.

<sup>22</sup> *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, Third Report and Order, Memorandum Opinion and Order, and Third Further Notice of Proposed Rulemaking, 33 FCC Rcd 5576 (2018), available at <https://docs.fcc.gov/public/attachments/FCC-18-73A1.pdf>.

<sup>23</sup> See Final Acts WRC-19, Resolution 242 at p. 351, Resolution 243 at p. 355.

<sup>24</sup> *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, GN Docket No. 14-177, Third Report and Order, Memorandum Opinion and Order, and Third Further Notice of Proposed Rulemaking, 33 FCC Rcd 5576 (rel. June 8, 2018), available at <https://docs.fcc.gov/public/attachments/FCC-18-73A1.pdf>.

<sup>25</sup> See Final Acts WRC-19, Resolution 243 at p. 355.

<sup>26</sup> *Incentive Auction of Upper Microwave Flexible Use Service Licenses in the Upper 37 GHz, 39 GHz, and 47 GHz Bands for Next Generation Wireless Services Closes*, Public Notice, 35 FCC Rcd 2015 (OEA/WTB Mar. 12, 2020), available at <https://docs.fcc.gov/public/attachments/DA-20-253A1.pdf>.

<sup>27</sup> See Final Acts WRC-19, Resolution 243 at p. 355.



| <b>Frequency Band</b>                    | <b>Repurposing Status – Through August 30, 2020</b>  |
|--|--|
| 42-42.5                                  | The FCC sought comment on potential shared use of the 42 GHz band. <sup>28</sup> WRC-19 identified this band for 5G. <sup>29</sup>   |
| 50.4–52.6                                | The FCC sought comment on making this band available for flexible terrestrial use, and it adopted rules to allow fixed-satellite service operators to operate with individually licensed earth stations transmitting in the 50.4-51.4 GHz portion of this band. <sup>30</sup> However, the WRC-19, the maintained a “no change” status for the 50.4-52.6 GHz allocation, and it was not identified for 5G. |
| 64-71                                    | The FCC made 7 gigahertz of unlicensed spectrum available in the 64-71 GHz band, adjacent to another 7 gigahertz of unlicensed spectrum in the 57-64 GHz band. <sup>31</sup>   |
| 71-76; 81-86; 92-94; 94.1-95             | The FCC sought comment to explore innovative uses of the 71-76 GHz, 81-86 GHz, 92-94 GHz, and 94.1-95 GHz bands including potential rule changes to allow for the provision of wireless backhaul for 5G and the deployment of broadband services to aircraft and ships. <sup>32</sup>  |
| 95-3000                                  | The FCC created a new category of experimental licenses for use of frequencies between 95 GHz and 3 Terahertz (THz). <sup>33</sup>   |
| 116-123, 174.8-182, 185-190, and 244-246 | The FCC made available just over 21 gigahertz of spectrum for unlicensed use in these bands with shared federal and non-federal allocations. <sup>34</sup>   |

<sup>28</sup> *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, GN Docket No. 14-177, Third Report and Order, Memorandum Opinion and Order, and Third Further Notice of Proposed Rulemaking, 33 FCC Rcd 5576 (rel. June 8, 2018), available at <https://docs.fcc.gov/public/attachments/FCC-18-73A1.pdf>.

<sup>29</sup> See Final Acts WRC-19, Resolution 242 at p. 351; Resolution 243 at p. 355.

<sup>30</sup> *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, GN Docket No. 14-177, Fifth Report and Order, 34 FCC Rcd 2556 (rel. Apr. 15, 2019), available at <https://docs.fcc.gov/public/attachments/FCC-19-30A1.pdf>.

<sup>31</sup> *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, GN Docket No. 14-177, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014 (rel. July 14, 2016), available at <https://ecfsapi.fcc.gov/file/0714115429654/FCC-16-89A1.pdf>.

<sup>32</sup> *Modernizing and Expanding Access to the 70/80/90 GHz Bands*, WT Docket No. 20-133, Notice of Proposed Rulemaking and Order, 35 FCC Rcd 6039 (rel. June 10, 2020), available at [https://docs.fcc.gov/public/attachments/FCC-20-76A1\\_Rcd.pdf](https://docs.fcc.gov/public/attachments/FCC-20-76A1_Rcd.pdf).

<sup>33</sup> *Spectrum Horizons*, ET Docket No. 18-21, First Report and Order, 34 FCC Rcd 1605 (rel. Mar. 21, 2019), available at <https://ecfsapi.fcc.gov/file/0321900915630/FCC-19-19A1.pdf>.

<sup>34</sup> *Id.* The Report and Order also made 21.2 GHz of spectrum available for unlicensed use.

## BACKGROUND

On October 25, 2018, President Donald J. Trump issued a *Presidential Memorandum* establishing a national policy for the efficient and effective use of radiofrequency spectrum “to help meet our economic, national security, science, safety, and other Federal mission goals now and in the future.”<sup>35</sup> Among other things, the *Presidential Memorandum* required the Secretary of Commerce, working through NTIA, and in coordination with the Office of Management and Budget (OMB), the Office of Science and Technology Policy (OSTP), and the FCC, to submit an annual report “on the status of existing efforts and planned near- to mid-term spectrum repurposing initiatives.”<sup>36</sup> Consistent with our country’s role as a technological and economic global leader in developing and deploying spectrum-dependent products and services, particularly commercial wireless systems, the President has deemed 5G a national priority and has given visibility to that priority in the spectrum policy realm throughout our reporting period – from the U.S. strategy at the World Radiocommunication Conference 2019 (WRC-19) in Sharm el Sheikh, Egypt,<sup>37</sup> to the efforts to deliver on a sustainable spectrum strategy called for in the *Presidential Memorandum*.

This is the second report under this mandate; it addresses accomplishments and activities during the period between July 1, 2019 and August 30, 2020.<sup>38</sup> To date, most repurposing activities and the statutory mandates for repurposing focus on accommodating non-federal uses; they also prioritize exclusive non-federal use over sharing.<sup>39</sup> These repurposing activities include ongoing regulatory proceedings and feasibility studies that address, for example, the reallocation of federal and non-federal spectrum bands to enable “wireless technologies capable

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<sup>35</sup> *Presidential Memorandum*, at Section 1.

<sup>36</sup> “Within 180 days of the date of this memorandum, and annually thereafter, the Secretary, working through the NTIA, and in coordination with the Office of Management and Budget (OMB), OSTP, and the Federal Communications Commission (FCC), shall submit to the President, through the Director of the National Economic Council and the Assistant to the President for National Security Affairs, a report (to be made public to the extent practicable and consistent with applicable law) on the status of existing efforts and planned near- to mid-term spectrum repurposing initiatives.” *Id.* at Section 3.

<sup>37</sup> “We . . . intend to maintain American leadership in 5G research, development, deployment and operation. This leadership will make 5G a technology force for benefitting peoples’ lives, in opposition to those who would use 5G as a tool to expand control of their own citizenry and to sow discord among nations.” Letter from President Donald J. Trump to International Telecommunication Union Secretary-General Houlin Zhao (Oct. 28, 2019), *available at* <https://twitter.com/AjitPaiFCC/status/1188851262424571905/photo/1>.

<sup>38</sup> Our first such report was released in August 2019, and addressed activities from January 1, 2018 through June 30, 2019. *See First Annual Report*. We note that a number of the actions discussed in this report were taken by the FCC, an independent agency, either exclusively or in coordination with the Executive Branch.

<sup>39</sup> *See, e.g.*, 47 U.S.C. § 923(j).

of meeting the high-capacity, low-latency, and high-speed requirements that can unleash innovation broadly across diverse sectors of the economy and the public sector.”<sup>40</sup>

The United States is making tremendous progress in repurposing spectrum for commercial wireless services – and that includes repurposing mid-band spectrum, with some 1130.5 megahertz already made available in total.<sup>41</sup> The most recent, and very significant, contribution comes from the White House’s announcement in August 2020 making the highly desirable 3450-3550 MHz band accessible for 5G deployment.<sup>42</sup> This is on the heels of an auction that commenced on July 23, 2020 for the Citizens Broadband Radio Service (CBRS) band (3550-3700 MHz), where an innovative three-tiered framework enables non-federal and federal shared use.<sup>43</sup> The FCC also has adopted an ambitious schedule to repurpose 280 MHz of C-band spectrum, with an auction scheduled to commence on December 8, 2020.<sup>44</sup> NTIA, in coordination with federal agencies, is continuing to study additional mid-band spectrum bands (e.g., 3100-3450 MHz and 1300-1350 MHz); and mid-band spectrum is the focus of an agenda item for the next World Radiocommunication Conference (WRC), scheduled for 2023. Through the hard work of many federal agencies, efforts have led to the successful repurposing of some 7,513 megahertz of spectrum across all bands, including mid-band spectrum. Further details of these repurposing efforts are provided in this report.

## LEGISLATIVE MANDATES

Efforts to repurpose spectrum have been ongoing for decades in response to the growth of and demand for commercial wireless and satellite services. Repurposing has been a facet of U.S. spectrum policy through multiple presidential administrations over the past 25 years. As policy evolved in the 1990s, Congress began a series of legislative actions, creating a framework to support federal spectrum repurposing efforts.<sup>45</sup> These included the establishment of the

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<sup>40</sup> *Presidential Memorandum*, Section 1.

<sup>41</sup> This total includes the L-Band uplinks and downlinks (30 megahertz), PCS (130 megahertz), AWS-1 (90 megahertz), AWS-3 (65 megahertz), AWS-4 (40 megahertz), H-Block (10 megahertz), WCS (30 megahertz), “Globalstar TLPS” (11.5 megahertz), BRS/EBS (194 megahertz), CBRS (150 megahertz), the C-Band (280 megahertz), and 3450-3550 MHz (100 megahertz). *See also supra* note 4.

<sup>42</sup> The White House, *Fact Sheet: President Donald J. Trump is Unleashing America’s 5G Potential* (Aug. 10, 2020), <https://www.whitehouse.gov/briefings-statements/president-donald-j-trump-unleashing-americas-5g-potential/>.

<sup>43</sup> *Auction of Priority Access Licenses for the 3550-3650 MHz Band – Comment Sought on Competitive Bidding Procedures for Auction 105*, AU Docket No. 19-244, Public Notice, 34 FCC Rcd 9215 (Sept. 27, 2019), available at <https://docs.fcc.gov/public/attachments/FCC-19-96A1.pdf>.

<sup>44</sup> *See, e.g., Auction of Flexible-Use Service Licenses in the 3.7-3.98 GHz Band for Next Generation Wireless Services*, AU Docket No. 20-25, Public Notice, FCC 20-110 (Aug. 7, 2020), available at <https://docs.fcc.gov/public/attachments/FCC-20-110A1.pdf>.

<sup>45</sup> Title VI of the Omnibus Budget Reconciliation Act of 1993 required that the Secretary of Commerce identify at least 200 megahertz of spectrum below 5 GHz used by the Federal Government for reallocation to new spectrum-

Spectrum Relocation Fund (SRF) to reimburse the costs associated with relocating federal spectrum uses to new bands.<sup>46</sup>

More recently, the Middle Class Tax Relief and Job Creation Act of 2012 and the Spectrum Pipeline Act of 2015 refined the tools available for NTIA and federal users to explore repurposing federal spectrum bands, including spectrum sharing.<sup>47</sup> The Spectrum Pipeline Act established a method for federal agencies to obtain SRF resources to conduct studies to improve the efficiency and effectiveness of their spectrum use. This allows federal agencies that propose spectrum “Pipeline Plans” to receive some of this funding tied to the likelihood of future potential auctions for research, development, engineering studies, economic analyses, and other activities to make available frequencies for reallocation and auction, including for shared use. The Spectrum Pipeline Act also required NTIA and the FCC to identify 130 megahertz of federal and non-federal spectrum for repurposing.

The MOBILE NOW Act of 2018 required the identification of spectrum for repurposing and called for studies and reports related to spectrum repurposing.<sup>48</sup> Specifically, section 603(a) of the Act requires NTIA and the FCC to identify 255 megahertz of federal and non-federal spectrum for mobile and fixed wireless broadband use by December 31, 2022. The Act requires that this 255 megahertz meet the following specifications: 100 megahertz below 8 GHz (unlicensed), 100 megahertz below 6 GHz (exclusively licensed for commercial mobile use), and 55 megahertz below 8 GHz (licensed or unlicensed). Any spectrum made available on or after February 11, 2016, otherwise satisfying the aforementioned requirements can be counted towards the Act’s 255 megahertz identification requirement.<sup>49</sup> Already, 691.5 megahertz of

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based technologies. *See* Pub. L. No. 103-66, Title VI, 107 Stat. 312, 380 (1993). In response, NTIA published a plan identifying twelve bands and a reallocation schedule for each. *See* NTIA, Spectrum Reallocation Final Report, NTIA Special Publication 95-32 (Feb. 1995). Title III of the Balanced Budget Act of 1997 required the FCC to identify 15 megahertz from the 1990-2110 MHz band for assignment by competitive bidding, but also provided a process for spectrum substitution to protect incumbent federal systems from interference if determined to better serve the public interest. *See* Pub. L. No. 105-33, Title III, 111 Stat. 251, 258-70 (1997).

<sup>46</sup> Congress enacted the Commercial Spectrum Enhancement Act in 2004 (Title II of Pub. L. No. 108-494), creating the SRF and facilitating the initial AWS auction of the 1710-1755 MHz band (AWS-1).

<sup>47</sup> *See* Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, Title VI, Subtitle G, 126 Stat. 245-55 (Feb. 22, 2012); Spectrum Pipeline Act of 2015, Pub. L. No. 114-74, Title X, 129 Stat. 621-24 (Nov. 2, 2015).

<sup>48</sup> *See* Consolidated Appropriations Act, 2018, Pub. L. No. 115-141, Division P, the Repack Airwaves Yielding Better Access for Users of Modern Services (RAY BAUM’S) Act, Title VI (the Making Opportunities for Broadband Investment and Limiting Excessive and Needless Obstacles to Wireless Act or MOBILE NOW Act), § 603 (Mar. 23, 2018).

<sup>49</sup> MOBILE NOW Act § 603. It additionally precluded the already identified frequencies of 1695-1710 MHz, 1755-1780 MHz, 2155-2180 MHz, and 3550-3700 MHz from satisfying the 255 megahertz requirement. *Id.*

licensed spectrum has been identified<sup>50</sup> since passage of the MOBILE NOW Act – with up to another 385 megahertz under assessment and slated for potential identification as licensed commercial spectrum<sup>51</sup> – as well as 1259 megahertz of spectrum for unlicensed operations identified in FCC proceedings that also will play a part in mobile broadband access.<sup>52</sup> As summarized in Table 2 below, the Spectrum Pipeline Act and the MOBILE NOW Act generally require NTIA or the FCC either to study the feasibility of, or develop rules for, new spectrum sharing in specific frequency bands, or to identify, for repurposing, spectrum bands meeting certain criteria or amounts specified in the legislation.

**TABLE 2**

| <i>Summary of Statutory Provisions Related to Spectrum Repurposing</i>  |
|---|
| <b>Requirements Regarding Specific Bands to be Repurposed</b>   |
| <ul style="list-style-type: none"> <li>• <i>MOBILE NOW</i> § 605(b): FCC 3700-4200 MHz sharing feasibility study               <ul style="list-style-type: none"> <li>○ Due date: September 23, 2019 (<i>MOBILE NOW</i> Act + 18 months)</li> </ul> </li> <li>• <i>MOBILE NOW</i> § 604: FCC 42-42.5 GHz service rules NPRM               <ul style="list-style-type: none"> <li>○ Due date: March 23, 2020 (<i>MOBILE NOW</i> Act + 2 years)</li> </ul> </li> <li>• <i>MOBILE NOW</i> § 605(a): NTIA 3100-3550 MHz sharing feasibility report               <ul style="list-style-type: none"> <li>○ Due Date: March 23, 2020 (<i>MOBILE NOW</i> Act + 24 months)</li> </ul> </li> <li>• <i>FAA Reauthorization Act of 2018</i> § 374: FCC, NTIA, and FAA joint report on UAS operations on the L-band and C-band               <ul style="list-style-type: none"> <li>○ Due Date: July 1, 2019 (<i>FAA</i> Act + 270 days)</li> </ul> </li> </ul> |

<sup>50</sup> Combining the licensed portion of the UHF TV Incentive Auction (70 megahertz), 900 MHz (6 megahertz), Educational Broadcasting Service (194 megahertz), the C-Band spectrum to be auctioned in December 2020 (280 megahertz), 3450-3550 MHz (100 megahertz) and the Ancillary Terrestrial Component (ATC) of the MSS L-Band and S-band(41.5 megahertz).

<sup>51</sup> Combining the potentially licensed portions of the 1300-1350 MHz band (30 megahertz), the 1675-1680 MHz band (5 megahertz), and the 3100-3450 MHz band (350 megahertz).

<sup>52</sup> Combining the 1200 megahertz use of the 6 GHz band (*Unlicensed Use of the 6 GHz Band*, ET Docket No. 18-295, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 3852, FCC 20-51 (rel. Apr. 24, 2020), available at <https://docs.fcc.gov/public/attachments/FCC-20-51A1.pdf>), the UHF TV Incentive Auction guard band (14 megahertz), and the potentially unlicensed portion of the 5.9 GHz band (45 megahertz).

## *Summary of Statutory Provisions Related to Spectrum Repurposing*

### **Requirements to Identify Spectrum Meeting Certain Criteria or Amounts**

- *Spectrum Pipeline* § 1004(a): Department of Commerce report to the President and FCC identifying 30 megahertz below 3 GHz for reallocation to non-federal or shared or both (excludes 1675-1695 MHz)
  - Due date: January 1, 2022, for report and to begin withdrawing or modifying federal assignments; July 1, 2024 for the FCC to begin auctioning spectrum
- *Spectrum Pipeline* § 1006(c)(1): FCC report for at least 50 megahertz of additional spectrum below 6 GHz for reallocation to non-federal use (licensed or shared) (excludes § 1004(a) spectrum)
  - Due date: January 1, 2022
- *Spectrum Pipeline* § 1006(c)(2): FCC report for at least 50 megahertz of additional spectrum below 6 GHz for reallocation to non-federal use (licensed or shared) (excludes § 1006(c)(1) spectrum and § 1004(a) spectrum)
  - Due date: January 1, 2024
- *MOBILE NOW* § 603(a): NTIA and FCC must identify 255 megahertz for mobile and fixed broadband use
  - 100 megahertz below 8 GHz for unlicensed
  - 100 megahertz below 6 GHz for licensed
  - 55 megahertz below 8 GHz for licensed or unlicensed or both
    - Due date: December 31, 2022

## **REPURPOSING INITIATIVES BY SPECTRUM BAND**

The following descriptions provide details for each band being repurposed. Further background information on each band can be found in the *First Annual Report*.

### **Low-Band Spectrum**

#### ***512-698 MHz UHF TV Incentive Auction***

The two-part 2016-2017 FCC broadcast incentive auction repurposed a total of 84 megahertz of spectrum, including 70 megahertz for licensed use and another 14 megahertz for wireless microphones and other unlicensed use, meeting the requirements to partially satisfy Section 603(a)(5) of the *MOBILE NOW* Act.

- Current Status: The post-auction transition to clear the 600 MHz band for new wireless licensees is complete. All repacked TV stations and band-changing reverse auction winners have vacated their pre-auction channels, meaning that all of the 600 MHz spectrum sold in the broadcast incentive auction has been cleared.<sup>53</sup> This allows all of the new wireless 600 MHz wireless licensees to commence operation on their new 600 MHz licenses.
- Next Steps: A small percentage of the repacked TV licensees are still in the process of completing construction of their final facilities and the program to reimburse relocation costs incurred by repacked stations will continue until no later than July 2023.

### ***800 MHz Band - Interstitial Channel Allocation***

The rebanding process in this band has substantially alleviated interference risk to public safety licensees, and the process, despite lasting longer than anticipated, is nearing completion.<sup>54</sup> The FCC's *800 MHz Rebanding Streamlining Order* required licensees that had completed reconfiguration of their systems to provide notice of any unresolved dispute, or a completion certification (if no unresolved disputes exist), by January 15, 2020.<sup>55</sup>

- Current Status: On March 23, 2020, the FCC released an Order “declaring the licensees [listed in the Order] as having completed rebanding.”<sup>56</sup>
- Next Steps: The dispute resolution process under the 800 MHz rebanding orders was set to be terminated.<sup>57</sup>

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<sup>53</sup> FCC, Broadcast Incentive Auction Transition Schedule, <https://www.fcc.gov/about-fcc/fcc-initiatives/incentive-auctions/transition-schedule>.

<sup>54</sup> 800 MHz Transition Administrator, LLC, *Quarterly Progress Report for the Quarter Ended December 31, 2019*, WT Docket No. 02-55 (Mar. 13, 2020), available at [https://ecfsapi.fcc.gov/file/10313373707297/Quarterly\\_Progress\\_Report\\_Q4\\_2019.pdf](https://ecfsapi.fcc.gov/file/10313373707297/Quarterly_Progress_Report_Q4_2019.pdf). Completion of physical reconfiguration occurs when all system infrastructure and radios have been retuned, the licensee has commenced operations on its assigned post-rebanding frequencies, and, when required by the rebanding agreement between Sprint and the licensee, pre-rebanding channels have been removed from the licensees' radios.

<sup>55</sup> *800 MHz Rebanding Streamlining Order*, 34 FCC Rcd 10208.

<sup>56</sup> *Improving Public Safety Communications in the 800 MHz Band*, WT Docket No. 02-55, Order, ¶ 1, 35 FCC Rcd 2850, DA 20-321 (PSHSB PLD rel. Mar. 23, 2020), available at <https://ecfsapi.fcc.gov/file/0323779106066/DA-20-321A1.pdf>.

<sup>57</sup> *Id.* at ¶ 7.



## ***900 MHz Band***

In March 2019, the FCC proposed a reconfiguration of the 900 MHz band (896-901/935-940 MHz) to facilitate the development of broadband technologies and services.<sup>58</sup> In October 2019, the FCC issued an Order<sup>59</sup> modifying the September 2018 FCC freeze on applications for new or expanded use of the 900 MHz band. The FCC announced this action was being taken to provide “greater flexibility” for incumbents to be able to relocate from the broadband segment proposed.

- **Current Status:** In May 2020, the FCC adopted a Report and Order reconfiguring the 900 MHz band to facilitate the development of broadband technologies and services, including for critical infrastructure uses.<sup>60</sup> The FCC established a 3 megahertz by 3 megahertz broadband segment in the band, and adopted a transition mechanism based primarily on negotiations between prospective broadband licensees and existing narrowband incumbent licensees.
- **Next Steps:** The FCC will take steps to prepare for the filing of applications from prospective broadband licensees.

## **Mid-Band Spectrum**

### ***1300-1350 MHz Band***

The Spectrum Efficient National Surveillance Radar (SENSR) program, which would replace the long-range federal radars currently operating in the 1215-1390 MHz band, received funding from the SRF after approval in 2017 to conduct analysis and planning studies to determine the feasibility of freeing-up at least 30 megahertz in the 1300-1350 MHz band.<sup>61</sup> In 2019, DoD also received SRF funding to assess sharing between incumbent DoD systems that are expected to remain in the band and potential new commercial systems. Freeing-up this spectrum could satisfy the requirement of Section 1004 of the Spectrum Pipeline Act to identify, by January

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<sup>58</sup> *Review of the Commission's Rules Governing the 896-901/935-940 MHz Band*, WT Docket No. 17-200, Notice of Proposed Rulemaking, 34 FCC Rcd 1550 (rel. Mar. 14, 2019), available at <https://docs.fcc.gov/public/attachments/FCC-19-18A1.pdf>.

<sup>59</sup> *Review of the Commission's Rules Governing the 896-901/935-940 MHz Band*, WT Docket No. 17-200, Order, 34 FCC Rcd 9369 (WTB rel. Oct. 9, 2019), available at <https://ecfsapi.fcc.gov/file/1009391605766/DA-19-1025A1.pdf>.

<sup>60</sup> *Review of the Commission's Rules Governing the 896-901/935-940 MHz Band*, WT Docket No. 17-200, Report and Order, Order of Proposed Modification, and Orders, 35 FCC Rcd 5183, FCC 20-67 (rel. May 14, 2020), available at <https://docs.fcc.gov/public/attachments/FCC-20-67A1.pdf>.

<sup>61</sup> The band is currently being studied by FAA, DoD, DHS, and NOAA (in an advisory role). Spectrum Efficient National Surveillance Radar (SENSR). *Fact Sheet*, [https://www.faa.gov/air\\_traffic/technology/sensr/](https://www.faa.gov/air_traffic/technology/sensr/).

2022, 30 megahertz of spectrum below 3 GHz for auction, by July 2024, to accommodate commercial wireless services.

- Current Status: The band is under active study. NTIA and relevant federal agencies are assessing various options for accelerating the time by which the spectrum could be accessed by the commercial services prior to it being made fully available.
- Next Steps: Studies are expected to be completed in time to support the repurposing decisions needed to enable an auction.

### ***1526-1536 MHz, 1627.5-1637.5 MHz and 1646.5-1656.5 MHz MSS L-Band***

In April 2020, the FCC approved with conditions license modification applications of Ligado Networks LLC (Ligado) with respect to the ancillary terrestrial component of its mobile satellite service (MSS) license in three band segments: base stations in the 1526-1536 MHz portion of the MSS downlink band, user equipment in the 1627.5-1637.5 MHz, and 1646.5-1656.5 MHz portions of the MSS uplink band.<sup>62</sup> There has been extensive analysis and testing focused on potential interference to the Global Positioning System (GPS),<sup>63</sup> and petitions seeking reconsideration and stay of the FCC's decision are pending.

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<sup>62</sup> See *Ligado Amendment to License Modification Applications IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and SAT-MOD-20151231-00091*, IB Docket No. 11-109, Order and Authorization, 35 FCC Rcd 3772, FCC 20-48 (rel. Apr. 22, 2020), available at <https://docs.fcc.gov/public/attachments/FCC-20-48A1.pdf>.

<sup>63</sup> See, e.g., Dep't of Transp., *Global Positioning System (GPS) Adjacent Band Compatibility Assessment*, Final Report (Apr. 2018), <https://www.transportation.gov/sites/dot.gov/files/docs/subdoc/186/dot-gps-adjacent-band-final-reportapril2018.pdf> (“DoT ABC Final Report”); NIST Technical Note 1952, *LTE Impacts on GPS*, Final Test Report (Feb. 15, 2017), <https://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.1952.pdf>; *FCC GPS Technical Working Group Final Report*, IB Docket No. 11-109 (June 30, 2011), available at <https://ecfsapi.fcc.gov/file/7021690471.pdf>; National Space-Based Positioning, Navigation, and Timing Systems Engineering Forum (NPEF), *Assessment of LightSquared Terrestrial Broadband System Effects on GPS Receivers and GPS-dependent Applications* (June 1, 2011), [https://www.ntia.doc.gov/files/ntia/publications/lightsquared\\_assessment\\_report\\_07062011.pdf](https://www.ntia.doc.gov/files/ntia/publications/lightsquared_assessment_report_07062011.pdf); NPEF, *Follow-On Assessment of LightSquared Ancillary Terrestrial Component Effects on GPS Receivers* (Jan. 19, 2012), [https://www.ntia.doc.gov/files/ntia/publications/npef\\_lsq\\_follow-on\\_test\\_report\\_final\\_public\\_release.pdf](https://www.ntia.doc.gov/files/ntia/publications/npef_lsq_follow-on_test_report_final_public_release.pdf); Roberson and Associates, LLC, *Final Report: GPS and Adjacent Band Co-Existence Study* (June 10, 2016), <https://ecfsapi.fcc.gov/file/60002112686.pdf>.

## ***1675-1680 MHz Band***

In a May 2019 NPRM, the FCC proposed to reallocate the 1675-1680 MHz band for shared use between incumbent federal operations and non-federal fixed or mobile (except aeronautical mobile) operations on a co-primary basis and sought comment on proposals for reallocation.<sup>64</sup>

- **Current Status:** NOAA is evaluating, under a study funded via the Spectrum Pipeline Act, whether and how to accommodate commercial wireless services in the band without compromising NOAA's mission to obtain and distribute meteorological data.<sup>65</sup>
- **Next Steps:** NOAA is expected to complete its spectrum pipeline study. The FCC is expected to issue a final determination on the proposed rules after considering NOAA's study and the public comments.

## ***1695-1710 MHz, 1755-1780 MHz and 2155-2180 MHz (AWS-3) Bands***

In January 2015, the FCC completed an auction of new, commercial AWS-3 licenses in the 1695-1710 MHz band, and in the paired 1755-1780 MHz and 2155-2180 MHz bands, based on rules the FCC had adopted to facilitate commercial access to bands through spectrum-sharing arrangements with incumbent federal users.<sup>66</sup> Federal agency systems continue to operate in the lower two bands where the broadband licensees will share the spectrum either temporarily until the federal incumbents vacate the band (*i.e.*, early entry) or indefinitely with certain federal systems in a limited number of locations.

The early-entry coordination, per the framework developed by NTIA and FCC, has been successful in enabling carrier deployments in the 1755-1780 MHz band in advance of most federal systems vacating the band.<sup>67</sup> Since federal systems are not relocating from the 1695-1710 MHz band, the sharing will be indefinite.

Several agencies modified their initial transition plans for vacating the spectrum to request additional funding, change their technical solution, and/or request an extension in the time

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<sup>64</sup> *Allocation and Service Rules for the 1675-1680 MHz Band*, Notice of Proposed Rulemaking and Order, GN Docket No. 19-116, 34 FCC Rcd 3552 (rel. May 13, 2019), available at <https://docs.fcc.gov/public/attachments/FCC-19-43A1.pdf>.

<sup>65</sup> See, e.g., NOAA, *Spectrum Reallocation Study: Solicitation Number SP-133E-17-RF-SpectrumReallocationStudy* (Apr. 13, 2017), <https://www.fbo.gov/notices/49c5770f499de8d04fe9267745785e2f>.

<sup>66</sup> *Amendment of the Commission's Rules with Regard to Commercial Operations in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz Bands*, GN Docket No. 13-185, Report and Order, 29 FCC Rcd 4610 (rel. Mar. 31, 2014), available at <https://docs.fcc.gov/public/attachments/FCC-14-31A1.pdf>.

<sup>67</sup> FCC and NTIA, *Coordination Procedures in the 1695–1710 MHz and 1755–1780 MHz Bands*, Notice, 79 Fed. Reg. 54710 (Sept. 12, 2014), available at [https://www.ntia.doc.gov/files/ntia/publications/fr\\_aws3\\_notice\\_09122014.pdf](https://www.ntia.doc.gov/files/ntia/publications/fr_aws3_notice_09122014.pdf).

required to vacate the spectrum. Some of these requests have been approved, and several still are pending decision. Extensions in time may be approved; however, the agency must operate on a non-interference basis for the time period beyond that identified in the initial transition plan.<sup>68</sup> Further information and status on AWS-3 transition can be obtained from the annual report generated by NTIA in accordance with Commercial Spectrum Enhancement Act.<sup>69</sup>

- Current Status: These bands have been repurposed via auction; transition is under way. NOAA continues to negotiate with the commercial licensees to establish a coordination agreement.
- Next Steps: NTIA will continue to oversee the transition process.

### ***2496-2690 MHz (“2.5 GHz”) Band***

In June 2019, the FCC rolled back restrictions on the types of entities eligible to hold 2.5 GHz licenses and eliminated educational use requirements so that incumbent and future licensees have more flexibility in using the spectrum.<sup>70</sup> A Public Notice released in January 2020 announced procedures for rural Tribal Nations to obtain access to unused 2.5 GHz spectrum for the communications needs of their communities *via* a priority filing window through September 2, 2020, with the remaining spectrum licenses expected to be auctioned.<sup>71</sup>

- Current Status: The FCC’s Rural Tribal Priority Window remained open through September 2, 2020.
- Next Steps: The FCC continues to review applications submitted during the Rural Tribal Priority Window. The FCC will auction the remaining spectrum licenses.

### ***3100-3550 MHz Band***

NTIA evaluated the 3100-3550 MHz band both as part of ongoing efforts to identify candidate bands for repurposing and in response to the directions of the MOBILE NOW Act. Early in the analysis, and as described in a technical report released in January 2020, NTIA determined that

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<sup>68</sup> NTIA, *Commercial Spectrum Enhancement Act (CSEA)—Annual Report for 2018* (Oct. 2019), at p. II-2, [https://www.ntia.doc.gov/files/ntia/publications/3397-ntia\\_2018\\_csea\\_report102819final.pdf](https://www.ntia.doc.gov/files/ntia/publications/3397-ntia_2018_csea_report102819final.pdf).

<sup>69</sup> See NTIA, *Commercial Spectrum Enhancement Act (CSEA)—Annual Report for 2019* (June 2020), [https://www.ntia.doc.gov/files/ntia/publications/ntia\\_2019\\_csea\\_report\\_june\\_2020.pdf](https://www.ntia.doc.gov/files/ntia/publications/ntia_2019_csea_report_june_2020.pdf).

<sup>70</sup> *Transforming the 2.5 GHz Band*, WT Docket No. 18-120, Report and Order, 34 FCC Rcd 5446 (July 19, 2019), available at <https://ecfsapi.fcc.gov/file/0711901905298/FCC-19-62A1.pdf>.

<sup>71</sup> *Wireless Telecommunications Bureau Announces Procedures for 2.5 GHz Rural Tribal Priority Window*, WT Docket No. 18-120, Public Notice, 35 FCC Rcd 308, DA 20-18 (Jan. 6, 2020), available at <https://ecfsapi.fcc.gov/file/01062185814033/DA-20-18A1.pdf>; *Transforming the 2.5 GHz Band*, GN Docket No. 18-120, Memorandum Opinion and Order, DA 20-819 (WTB rel. Jul. 31, 2019), available at <https://docs.fcc.gov/public/attachments/DA-20-819A1.pdf>.

the 3450-3550 MHz portion of this mid-band spectrum held the greatest promise for quicker repurposing and focused its efforts accordingly.<sup>72</sup> The report indicated that spectrum sharing providing both sufficient protection to incumbent operations and an attractive business case to prospective commercial operations may be possible, and that further analysis was warranted – including studying the efficacy of appropriate time-based sharing mechanisms. The next steps identified in the *NTIA 3450-3550 MHz Technical Feasibility Report* focused on the further work needed to enable potential sharing of the 3450-3550 MHz band. An NTIA report on the full 3100-3550 MHz band indicated that further sharing below 3450 MHz may be possible, particularly as mechanisms for dynamic, time-based sharing are developed and tested.<sup>73</sup>

Based significantly upon these efforts and subsequent White House-led meetings, President Trump announced in August 2020 that the 3450-3550 MHz band would be made available to commercial wireless services for 5G deployment on an expedited basis.<sup>74</sup> This was achieved in no small part due to DoD’s accelerated efforts to carefully ensure that commercial use would not compromise military preparedness or national security.

In December 2019, the FCC issued an NPRM proposing to remove non-federal secondary radiolocation and amateur allocations in the 3300-3550 MHz band in preparation for potential sharing of the band with commercial wireless consistent with the MOBILE NOW Act.<sup>75</sup> In August 2020, the FCC indicated that it would move quickly to adopt service rules for the 3.45 GHz band to hold an auction to bring this spectrum to market.

- **Next Steps:** The FCC will issue a Notice of Proposed Rule Making to facilitate an auction of licenses for use of frequencies in the 3450-3550 MHz sub-band, and DoD will finalize and submit a transition plan to recover its reasonable costs. DoD and NTIA also intend to study the feasibility of additional sharing within the remaining 3100-3450 MHz portion of the band.

### ***3550-3700 MHz (CBRS Band)***

The Citizens Broadband Radio Service (CBRS) band is facilitated by a novel spectrum sharing methodology through employment of a three-tiered licensing and access framework that places incumbent users in the highest tier (receiving protection from every other user), Priority Access

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<sup>72</sup> See *NTIA 3450-3550 MHz Technical Feasibility Report*.

<sup>73</sup> NTIA, *Feasibility of Commercial Wireless Services Sharing with Federal Operations in the 3100-3550 MHz Band* (July 2020), [https://www.ntia.doc.gov/files/ntia/publications/ntia\\_3100-3550\\_mhz\\_mobile\\_now\\_report\\_to\\_congress.pdf](https://www.ntia.doc.gov/files/ntia/publications/ntia_3100-3550_mhz_mobile_now_report_to_congress.pdf).

<sup>74</sup> The White House, *Fact Sheet: President Donald J. Trump is Unleashing America’s 5G Potential* (Aug. 10, 2020), <https://www.whitehouse.gov/briefings-statements/president-donald-j-trump-unleashing-americas-5g-potential/>.

<sup>75</sup> *Facilitating Shared Use in the 3.1-3.55 GHz Band*, WT Docket No. 19-348, Notice of Proposed Rulemaking, 34 FCC Rcd 12662 (rel. Dec. 16, 2019), available at <https://ecfsapi.fcc.gov/file/121661888341/FCC-19-130A1.pdf>.

License (PAL) users in the second tier (receiving protection from GAA users), and General Authorized Access (GAA) users in the final tier.<sup>76</sup> Spectrum Access Systems (SASs) are “automated frequency coordinators” that coordinate operations between the different user tiers.<sup>77</sup> On September 16, 2019, the FCC issued a Public Notice approving initial commercial deployments of five SAS Administrators.<sup>78</sup> On January 27, 2020, after reviewing CommScope’s, Google’s, Sony’s, and Federated Wireless’s Initial Commercial Deployment (ICD) reports, the FCC certified these SAS Administrators complied with Part 96 rule requirements and authorized them to make their SAS available for commercial use over a five-year term.<sup>79</sup> On April 21, 2020 the FCC also authorized Amdocs to make its SAS available for commercial use.<sup>80</sup> On August 25, 2020, the FCC concluded the auction of PALs.<sup>81</sup>

- Current Status: Five SASs are commercially operational supporting GAA operations. Bidding in an auction for PALs concluded on August 25, 2020. Auction 105 raised a total of \$4,543,232,339 in net bids (\$4,585,663,345 in gross bids), with 228 bidders winning a total of 20,625 licenses.
- Next Steps: The FCC will perform post-auction activities, including reviewing FCC long-form applications and awarding PALs to successful auction winners. NTIA and the FCC will continue to monitor the success of the novel sharing framework.

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<sup>76</sup> *Promoting Investment in the 3550-3700 MHz Band*, GN Docket No. 17-258, Order, 33 FCC Rcd 4987 (WTB/OET rel. May 22, 2018), available at <https://ecfsapi.fcc.gov/file/0522188222724/DA-18-538A1.pdf>.

<sup>77</sup> *Id.*

<sup>78</sup> *Wireless Telecommunications Bureau and Office of Engineering and Technology Approve Five Spectrum Access System Administrators to Begin Initial Commercial Deployments in the 3.5 GHz Band*, GN Docket No. 15-319, Public Notice, 34 FCC Rcd 8106 (Sept. 16, 2019), available at <https://docs.fcc.gov/public/attachments/DA-19-915A1.pdf>.

<sup>79</sup> *Wireless Telecommunications Bureau and Office of Engineering and Technology Approve Four Spectrum Access System Administrators for Full Scale Commercial Deployment in the 3.5 GHz Band and Emphasize Licensee Compliance Obligations in the 3650-3700 MHz Band Under Part 96*, GN Docket No. 15-319, Public Notice, 35 FCC Rcd 117 (WTB/OET Jan. 27, 2020), available at <https://ecfsapi.fcc.gov/file/0127193875857/DA-20-110A1.pdf>.

<sup>80</sup> *Wireless Telecommunications Bureau and Office of Engineering and Technology Approve Spectrum Access System Administrator Amdocs for Full Scale Commercial Deployment in the 3.5 GHz Band*, GN Docket No. 15-319, Public Notice, 35 FCC Rcd 3687, DA 20-437 (WTB/OET Apr. 21, 2020), available at <https://docs.fcc.gov/public/attachments/DA-20-437A1.pdf>.

<sup>81</sup> *Auction of Priority Access Licenses in the 3550-3650 MHz Band Closes*, AU Docket No. 19-244, Public Notice, DA 20-1009 (WTB/OEA Sept. 2, 2020), available at <https://docs.fcc.gov/public/attachments/DA-20-1009A1.pdf>.



### ***3700-3980 MHz Band (C-Band)***

On February 28, 2020, the FCC approved a proposal to auction licenses for commercial wireless services in the lower 280 megahertz (3700-3980 MHz) of the C-Band and to consolidate incumbent satellite operations in the 4000-4200 MHz portion of the band. The new commercial wireless licensees will pay the relocation costs of the C-band satellite operations as well as “acceleration payments” to the satellite incumbents who voluntarily choose to clear the band on an expedited basis.<sup>82</sup> On August 7, 2020, the FCC released the procedures for the auction and announced it is scheduled to commence on December 8, 2020.<sup>83</sup>

- Next Steps: The FCC plans to commence an auction on December 8, 2020.

### ***4900-4990 MHz Band***

The FCC allocated 50 megahertz (4940-4990 MHz) of spectrum in the 4.9 GHz band for fixed and mobile services and designated the band for public safety support. It adopted service rules in 2003 to encourage state and local agencies to benefit from high-speed applications like real-time video, data downloads, and short-range wireless networking at emergency incidents. Public safety entities can enter into sharing agreements with utilities, federal government agencies, and others in support of public safety and homeland security. The FCC has had an ongoing rulemaking proceeding open for approximately 10 years to examine the 4.9 GHz public safety spectrum band and potentially modify the service rules, as it has indicated the band appears lightly used and should be explored for commercial use. In March 2018, the FCC released a comprehensive Sixth Further Notice of Proposed Rulemaking.<sup>84</sup> The entire 4800-4990 MHz band is now the subject of increased foreign attention as a potential band for wireless commercial broadband. An agenda item for WRC-23 will consider possible measures to address protection of stations of the aeronautical and maritime mobile services located in international airspace and waters.<sup>85</sup>

- Current Status: The FCC proceeding remained open at the end of the period covered in this report. Internationally, several administrations have identified the entire 4800-4990

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<sup>82</sup> *Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, GN Docket No. 18-122, Report and Order and Order of Proposed Modification, 35 FCC Rcd 2343, FCC 20-22 (rel. Mar. 3, 2020), available at <https://docs.fcc.gov/public/attachments/FCC-20-22A1.pdf>.

<sup>83</sup> *Auction of Flexible-Use Service Licenses in the 3.7 to 3.98 GHz Band for Next Generation Wireless Services*, AU Docket No. 20-25, Public Notice, FCC 20-110 (Aug. 7, 2020), available at <https://docs.fcc.gov/public/attachments/FCC-20-110A1.pdf>.

<sup>84</sup> *Amendment of Part 90 of the Commission's Rules*, Sixth Further Notice of Proposed Rulemaking, 33 FCC Rcd 3261 (rel. Mar. 23, 2018), available at <https://ecfsapi.fcc.gov/file/03231913715191/FCC-18-33A1.pdf>.

<sup>85</sup> See Final Acts WRC-19, Resolution 811 at p. 541.



MHz band as a prime candidate for 5G.

- Next Steps: The United States will engage in the WRC-23 study group cycle as it studies the 4800-4990 MHz band to ultimately determine if it can be identified internationally for 5G.

### ***5850-5925 MHz Band***

Unlicensed National Information Infrastructure (U-NII) devices currently operate in four frequency bands in the 5 GHz range, totaling 580 megahertz of spectrum.<sup>86</sup> The 5850-5925 MHz band currently is allocated on a primary basis to the non-federal mobile service with use limited to the Dedicated Short Range Communications (DSRC) for Intelligent Transportation System (ITS) services. The band is also allocated on a primary basis to the federal Radiolocation service, so roadside DSRC units must accept any interference from and be coordinated with federal Radiolocation operations within 75 kilometers of designated military installations. Other co-primary users include fixed satellite services (FSS) and indoor Industrial, Scientific, and Medical (ISM) uses. Amateur radio operators (including amateur radio emergency data network (AREDN) operators) use this band in an unlicensed, secondary capacity.

The FCC agreed in a letter to Congress that it would work with the Departments of Commerce and Transportation to evaluate sharing options in the lower 45 MHz between U-NII and DSRC. On December 12, 2019, the FCC proposed rules that would create separate spectrum segments for unlicensed devices and transportation/vehicular safety-related applications, designating the lower 45 megahertz of the band for unlicensed use, including Wi-Fi, and the upper 30 megahertz for automotive safety applications, with LTE C-V2X in the upper 20 megahertz and DSRC potentially in the remaining 10 megahertz.<sup>87</sup> At that time, the FCC ceased issuing new DSRC licenses.

As is the case with DSRC, rules would also need to be put in place to ensure LTE C-V2X and Wi-Fi do not cause interference with the federal Radiolocation service.

- Next Steps: The FCC is pursuing new rules in the 5.9 GHz band to make efficient use of this mid-band spectrum.

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<sup>86</sup> *The Commission Seeks to Update and Refresh the Record in the “Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band” Proceeding*, ET Docket No. 13-49, Public Notice, 31 FCC Rcd 6130, 6131-32 (June 1, 2016), available at [https://apps.fcc.gov/edocs\\_public/attachmatch/FCC-16-68A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-68A1.pdf).

<sup>87</sup> *Use of the 5.850-5.925 GHz Band*, ET Docket No. 19-138, Notice of Proposed Rulemaking, 34 FCC Rcd 12603 (rel. Dec. 19, 2019), available at <https://docs.fcc.gov/public/attachments/FCC-19-129A1.pdf>.

### ***5925-6425 MHz and 6425-7125 MHz Bands***

In April 2020 the FCC adopted rules for unlicensed use of the 6 GHz band (5925-7125 MHz).<sup>88</sup> Under these rules, in the 5.925-6.425 GHz and 6.525-6.875 GHz sub-bands unlicensed access points can transmit both indoors and outdoors under the control of an automated frequency coordination (AFC) system. Across the entire 6 GHz band, unlicensed access points may operate at lower power restricted to indoor use, without an AFC system. Client devices may connect to either type of access point. These new rules are expected to be instrumental in meeting the growing need for wireless connectivity and address the expected growth of Wi-Fi and IoT devices. The new rules are designed to allow this spectrum to be more intensively used by the unlicensed devices, while protecting existing licensed services (including microwave links, mobile news gathering (broadcast auxiliary service), satellite uplinks, and a limited number of satellite downlinks). Meanwhile, an agenda item at WRC-23 will potentially identify 7025-7125 MHz internationally as mid-band spectrum appropriate for 5G.<sup>89</sup>

- **Next Steps:** The FCC will consider further expanding unlicensed use of the band by a new class of very low power devices. Internationally, the United States will engage in the WRC-23 study group as it studies the bands, including conducting feasibility studies.

### **High-Band Spectrum**

#### ***Spectrum above 24 GHz: the FCC's Spectrum Frontiers Proceeding***

Technological advances allow spectrum in the millimeter wave bands, historically used for satellite and terrestrial point-to-point applications, to bring very high speeds and low latency to advanced wireless services, particularly for 5G and beyond technologies. In the Spectrum Frontiers proceeding, the FCC has adopted rules to permit fixed and mobile use of a number of bands above 24 GHz under flexible rules suitable for deployment of 5G. Prior to this proceeding these bands had been jointly allocated for the fixed, mobile, and fixed satellite services but the only actual use was for a small number of fixed microwave systems in a few bands. The FCC has adopted these new rules for the 24 GHz (24.25-24.45 GHz, 24.75-25.25 GHz), 28 GHz (27.5-28.35 GHz), Upper 37 GHz (37.6-38.6 GHz), 39 GHz (38.6-40 GHz), and 47 GHz (47.2-48.2 GHz) bands. The FCC has proposed to apply these rules to the 42-42.5 GHz and 50.4-52.6 GHz bands and sought comment on applying these rules to the 26 GHz band (25.25-27.5 GHz). The FCC also adopted a framework for shared use of the Lower 37 GHz band (37-37.6 GHz). The

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<sup>88</sup> *Unlicensed Use of the 6 GHz Band*, ET Docket No. 18-295, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 3852, FCC 20-51 (rel. Apr. 24, 2020), available at <https://docs.fcc.gov/public/attachments/FCC-20-51A1.pdf>.

<sup>89</sup> See Final Acts WRC-19, Resolution 245 at p. 363, Resolution 811 at p. 541.

FCC concluded an auction of licenses in the 28 GHz band in January 2019,<sup>90</sup> an auction of licenses in the 24 GHz band in May 2019,<sup>91</sup> and an auction of licenses in the Upper 37 GHz, 39 GHz, and 47 GHz bands on March 5, 2020.<sup>92</sup>

Internationally, the United States supported identification<sup>93</sup> for 5G in three frequency ranges at WRC-19 based on existing domestic decisions: (1) the 24.25-27.5 GHz band, (2) the 37-43.5 GHz tuning range, and (3) the 47.2-48.2 GHz band. It supported NOC (or “no change”) in the remaining frequency ranges – and to gain consensus for that outcome as soon as possible at the Conference in order to focus the remaining time on the bands most likely to gain global harmonization for 5G. Overall, at WRC-19, the United States was successful in identifying 17.25 gigahertz of additional spectrum for IMT in North America, 14.75 gigahertz of which is harmonized globally. In addition, the United States successfully protected the rights of incumbent systems to maintain access to these key spectrum bands. The United States was successful in maintaining a NOC proposal in most frequency bands, and when one could not be held, ensuring no additional impacts on current and planned U.S. operations in the bands. The bands 31.8-33.4 GHz, 48.2-50.2 GHz, 50.4-52.6 GHz, 71-76 GHz, and 81-86 GHz bands remained as “no change.”

- Next Steps: NTIA and the FCC will continue discussion on the methodology for sharing the Lower 37 GHz band between Federal and non-Federal users. Some bands above 24 GHz remain under consideration for flexible use licensing. NTIA continues to work with federal agency spectrum users to assess and study potential impacts to in-band and adjacent-band operations, existing and planned, to avoid interrupting critical missions.

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<sup>90</sup> The FCC 28 GHz Auction, Auction 101, netted \$700,309,809. *Winning Bidders Announced for Auction of 28 GHz Upper Microwave Flexible Use Service Licenses (Auction 101)*, AU Docket No. 18-85, Public Notice, 34 FCC Rcd 4279 (June 3, 2019), available at <https://docs.fcc.gov/public/attachments/DA-19-484A1.pdf>.

<sup>91</sup> The FCC 24 GHz Auction, Auction 102, netted \$2,022,676,752. *Auction of 24 GHz Upper Microwave Flexible Use Service Licenses Closes; Winning Bidders Announced for Auction 102*, AU Docket No. 18-85, Public Notice, 34 FCC Rcd 4294 (June 3, 2019), available at <https://docs.fcc.gov/public/attachments/DA-19-485A1.pdf>.

<sup>92</sup> The FCC Upper 37 GHz, 39 GHz, and 47 GHz auction, Auction 103, netted \$4,474,530,303. *Incentive Auction of Upper Microwave Flexible Use Service Licenses in the Upper 37 GHz, 39 GHz, and 47 GHz Bands for Next-Generation Wireless Services Closes; Winning Bidders Announced for Auction 103*, AU Docket No. 19-59, Public Notice, 35 FCC Rcd 2015 (Mar. 12, 2020), available at <https://docs.fcc.gov/public/attachments/DA-20-253A1.pdf>.

<sup>93</sup> An *identification* of spectrum is an international concept that provides guidance to countries internationally on a specific spectrum allocation that may be used by a large number of countries for a specified use.

### ***71-76 GHz, 81-86 GHz, 92-94 GHz, and 94.1-95 GHz Bands***

In June 2020 the FCC sought comment on innovative uses of the 71-76 GHz, 81-86 GHz, 92-94 GHz, and 94.1-95 GHz bands including potential rule changes to allow for the provision of wireless backhaul for 5G and the deployment of broadband services to aircraft and ships.<sup>94</sup>

- Next Steps: The FCC is reviewing public comments and will consider opportunities for expanded, licensed commercial operations in this spectrum.

### ***Above 95 GHz: the FCC's Spectrum Horizons Proceeding***

In 2019, the FCC released a Report and Order that created a new class of experimental licenses for use of spectrum above 95 GHz (and below 3 THz) that provide for increased flexibility.<sup>95</sup> The Report and Order also made a total of 21.2 gigahertz of spectrum available for use by unlicensed devices at 116-123 GHz, 174.8-182 GHz, 185-190 GHz, and 244-246 GHz. The FCC crafted the bands selected so as to permit large numbers of unlicensed devices to use the spectrum, while limiting the potential for interference to existing governmental and scientific operations in the above-95 GHz bands, such as space research and atmospheric sensing.

- Next Steps: The FCC is considering opportunities for licensed commercial operation in this spectrum.

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<sup>94</sup> *Modernizing and Expanding Access to the 70/80/90 GHz Bands*, WT Docket No. 20-133, Notice of Proposed Rulemaking and Order, 35 FCC Rcd 6039 (rel. June 10, 2020), available at [https://docs.fcc.gov/public/attachments/FCC-20-76A1\\_Rcd.pdf](https://docs.fcc.gov/public/attachments/FCC-20-76A1_Rcd.pdf).

<sup>95</sup> *Spectrum Horizons*, ET Docket No. 18-21, First Report and Order, 34 FCC Rcd 1605 (rel. Mar. 21, 2019), available at <https://docs.fcc.gov/public/attachments/FCC-19-19A1.pdf>.

## CONCLUSION

The United States is making great progress in repurposing spectrum to support commercial wireless services – especially in mid-band spectrum – while ensuring the protection of critical federal missions. NTIA and the FCC are working hard to make certain that the United States leads the world in 5G and beyond in innovation and deployment. American leadership in these technologies will depend on advances that greatly improve the spectrum efficiency and effectiveness of federal operations, along with ongoing efforts to assess the Nation’s spectrum needs and to identify additional bands with federal and non-federal allocations to serve those needs. This will entail examining and implementing effective measures for protecting incumbent services and managing the transitions as spectrum uses shift and new spectrum-sharing tools and techniques are developed and implemented. These ongoing efforts constitute a process that resembles a “pipeline” for continuous identification and assessment of bands, followed by repurposing or implementing other spectrum access mechanisms to serve the nation’s interests. Going forward, NTIA, in collaboration with the FCC, other federal partners, and non-federal stakeholders, will continue to focus on identifying new candidate spectrum bands for potential repurposing while still preserving critical federal capabilities.