Sixth Interim Progress Report on the Ten-Year Plan and Timetable

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TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
Key Accomplishments 2
INTRODUCTION 4
Background 4
Scope 5
ACTIVITIES AND ACCOMPLISHMENTS 5
Advanced Wireless Services-3 (AWS-3) 7
AWS-3 Auction 8
Coordination Between AWS-3 Licensees and Federal Incumbents 8
3.5 GHz Citizens Broadband Radio Service 9
Incentive Auction 11
5 GHz Unlicensed (U-NII) Services 12
Spectrum Frontiers 14
Related Activities 14
Quantitative Assessments of Spectrum Usage 14
International Activities 16
Proposed Model City for Demonstrating and Evaluating Advanced Spectrum Sharing Technologies 16
ACTIVITIES FOR THE NEXT TWELVE MONTHS 17
CONCLUSION 18

EXECUTIVE SUMMARY

This Sixth Interim Progress Report on the Ten-Year Plan and Timetable (*Sixth Interim Progress Report*) catalogs progress toward achieving the Administration's goal, established in 2010, to identify and make available 500 megahertz of spectrum for commercial broadband wireless services within ten years, while assuring the protection of vital government operations that rely on spectrum.[1] This report covers the period from October 1, 2014 through September 30, 2015 (FY15).[2] As of the end of FY15, the National Telecommunications and Information Administration (NTIA) and the Federal Communications Commission (FCC) have made significant progress, realizing nearly half of the 500 megahertz goal by making a total of 245 megahertz of spectrum available,[3] including 165 megahertz during this period.

The 245 megahertz made available consists of the following spectrum:

- Federal or shared bands (140 megahertz total)
  - 40 megahertz from the 1695-1710 MHz and 1755-1780 MHz bands
  - 100 megahertz from the 3.5 GHz band (3550-3650 MHz)
- Non-federal bands (105 megahertz total)
  - 30 megahertz from the 2305-2320 MHz and 2345-2360 MHz bands
  - 10 megahertz from the 1915-1920 MHz and 1995-2000 MHz bands
  - 40 megahertz from the 2000-2020 MHz and 2180-2200 MHz bands
  - 25 megahertz from the 2155-2180 MHz band

Activities since the *Fifth Interim Report*[4] have focused on making spectrum already studied available for commercial wireless services, and on continuing studies of additional spectrum toward meeting our 500 megahertz goal.

Accomplishments to date are a result of the continued collaboration between NTIA, the FCC, the federal agencies, industry, and other stakeholders. This successful collaboration in

[1] Memorandum for the Heads of Executive Departments and Agencies, *Unleashing the Wireless Broadband Revolution* (rel. June 28, 2010) *published at* 75 Fed. Reg. 38387 at § 1(d) (July 1, 2010) *available at* http://www.whitehouse.gov/the-press-office/presidential-memorandum-unleashing-wireless-broadband-revolution (*2010 Presidential Memorandum*). The Memorandum directs the Secretary of Commerce, working through NTIA and in collaboration with the Federal Communications Commission (FCC), to identify and make available 500 megahertz of federal and non-federal spectrum by 2020 for new wireless broadband services. *Id*. at § 1(a).

[2] All years not explicitly indicated in this document as fiscal years are calendar years.

[3] Atkins, Paige R., Associate Administrator, Office of Spectrum Management, National Telecommunications and Information Administration, *Nearly Halfway to Meeting Spectrum Target* (July 8, 2015), *available at* http://www.ntia.doc.gov/blog/2015/nearly-halfway-meeting-spectrum-target (*Ten-Year Plan Status Blog Post*).

[4] NTIA, *Fifth Interim Progress Report on the Ten-Year Plan and Timetable* at 1-2 (April 14, 2015) *available at* http://www.ntia.doc.gov/files/ntia/publications/ntia_5th_interim_progress_report_on_ten-year_timetable_april_2015.pdf (*Fifth Interim Report*).

implementing NTIA's *Ten Year Plan* will continue to fulfill the mandates of the *2010 Presidential Memorandum*, the *Tax Relief Act*, and the *2013 Presidential Memorandum* to provide additional spectrum for licensed and unlicensed wireless broadband services.[5]

Key Accomplishments

The key accomplishments during FY15 include:

- **Advanced Wireless Services**—The FCC auctioned AWS-3 licenses in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz bands, with total provisional net bids exceeding $41 billion, providing funding for Congressional priorities, including the First Responder Network Authority (FirstNet) and deficit reduction.
- **3.5 GHz Citizens Broadband Radio Service**—The FCC adopted new service and licensing rules to create an innovative service in the 3550-3700 MHz (3.5 GHz) band. Based on new NTIA technical studies conducted in collaboration with the Department of Defense (DOD) and the FCC, the new rules significantly increase commercial access to the 3550-3650 MHz portion of the band in geographic areas near federal radars.
- **Incentive Auction**—The FCC adopted procedures for conducting a voluntary incentive auction in the 512-698 MHz (600 MHz) band in order to make additional low-band spectrum available for mobile broadband and other services, while allowing market forces to choose between competing commercial uses of spectrum.
- **5 GHz Unlicensed Services**—NTIA, the FCC, and other stakeholders conducted further studies to identify new techniques to potentially achieve compatibility between unlicensed devices and incumbent federal and non-federal systems in the proposed 5350-5470 MHz and 5850-5925 MHz U-NII bands.
- **Quantitative Assessments of Spectrum Usage**—NTIA and the federal agencies validated agency frequency assignment data and developed a tool to analyze and portray the extent to which federal agencies use certain frequency bands.
- **Spectrum Frontiers**—The FCC, in coordination with NTIA, issued a Notice of Inquiry examining the potential use of frequency bands above 24 GHz for mobile broadband and other flexible uses.
- **International Activities**—NTIA, the FCC, and other U.S. stakeholders developed proposals for international designation of frequency bands for mobile broadband services at the 2015 World Radiocommunication Conference (WRC-15).

[5] NTIA, *Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband* (Oct. 2010) *available at* http://www.ntia.doc.gov/files/ntia/publications/tenyearplan_11152010.pdf (*Ten-Year Plan*); *Middle Class Tax Relief and Job Creation Act of 2012*, Pub. L. No. 112-96, §§ 6401, 6403, 6406-6407, 47 U.S.C. §§ 1451-1454 (2013) (*Tax Relief Act*); Memorandum for the Heads of Executive Departments and Agencies, *Expanding America's Leadership in Wireless Innovation* (rel. June 14, 2013) *published at* 78 Fed. Reg. 37431 (June 20, 2013) *available at* http://www.whitehouse.gov/the-press-office/2013/06/14/presidential-memorandum-expanding-americas-leadership-wireless-innovatio (*2013 Presidential Memorandum*).

- **Model City Initiative**—NTIA and the FCC held a workshop and roundtable to further develop governance and technical proposals toward a collaborative Model City program that will contribute to improved understanding of characteristics of real-world radio frequency environments.

INTRODUCTION

NTIA submits this *Sixth Interim Progress Report* to describe progress toward achieving the Administration's directive to identify and make available 500 megahertz of spectrum for licensed and unlicensed wireless broadband services within ten years, while assuring the protection of vital government operations that rely on spectrum.[6] This report covers October 1, 2014 through September 30, 2015 (FY15). As of September 2015, NTIA and the FCC had made significant progress toward the goal by making a total of 245 megahertz of spectrum available for wireless broadband technologies, including 165 megahertz during FY15.[7] This spectrum is comprised of 140 megahertz from federal or shared bands and 105 megahertz from non-federal bands. Accomplishments to date are a result of the continued collaboration between NTIA, the FCC, the federal agencies, industry, and other stakeholders.

Background

The *2010 Presidential Memorandum* directed NTIA to "collaborate with the Federal Communications Commission…to make available a total of 500 MHz of Federal and nonfederal spectrum" within ten years for wireless broadband use.[8] Pursuant to this requirement, and with input from federal agencies participating through its Policy and Plans Steering Group (PPSG), NTIA published its *Ten-Year Plan* in October 2010.

In 2012, Congress enacted Title VI of the *Tax Relief Act*, which called for the repurposing and auction of several frequency bands, provided authority for incentive auctions and the use of auction proceeds, and specified procedures for the transition to mobile broadband use of the spectrum and for federal system relocation and spectrum sharing. NTIA and the FCC have made significant progress implementing key provisions of the *Tax Relief Act*.[9]

On June 14, 2013, President Obama issued a second, related memorandum, entitled *Expanding America's Leadership in Wireless Innovation*, which encouraged shared access by

[6] *2010 Presidential Memorandum* at § 1(d).

[7] *See Ten-Year Plan Status Blog Post.*

[8] *2010 Presidential Memorandum* at § 1(a). The *2010 Presidential Memorandum* directed NTIA to convene the PPSG, a group of senior federal officials who advise NTIA on achieving the objectives of the memorandum. *Id*. at § 1(c).

[9] *Tax Relief Act*, §§ 6401-6407, 6701-6703. Section 6401 pertains to the H-Block auction (Auction 96, which occurred in January and February 2014) and the AWS-3 auction (Auction 97, occurring November 2014 through January 2015). Sections 6402-6403 and 6407 pertain to the UHF TV Incentive Auction (Auction 1000, scheduled to begin in March 2016), while Section 6406 addresses the 5 GHz U-NII bands, for which compatibility studies continue.

commercial providers to spectrum allocated for federal use.[10] The memorandum also recognized the national interest in protecting current and future government operations.[11]

Scope

This *Sixth Interim Progress Report* describes NTIA's FY15 progress executing its *Ten-Year Plan* to identify and make available 500 megahertz of spectrum for commercial broadband wireless services. NTIA's *Fifth Interim Progress Report* stated that NTIA and the FCC had identified up to 589 megahertz of spectrum to study for potential reallocation.[12] During FY15, NTIA and the FCC focused on making spectrum already studied available for commercial wireless services and on continuing studies of additional spectrum. The following sections summarize key activities and accomplishments and look ahead to the next study period, ending in September 2016.

ACTIVITIES AND ACCOMPLISHMENTS

During FY15, NTIA and the FCC, cooperating with the federal agencies through the PPSG, continued to make substantial progress on the President's goal of making 500 megahertz of spectrum available for wireless broadband. Table 1 below shows the status of repurposing by frequency band, including the 245 megahertz already made available and up to an additional 1,286 megahertz that either has been identified and is in the repurposing process, is under study for repurposing, or is being considered for future study.[13] In addition, although not reflected in the chart, the FCC, in its *Spectrum Frontiers* proceeding, is examining making significant additional amounts of spectrum above 24 GHz available for flexible wireless uses, including mobile broadband.[14] While these bands were not generally considered viable for mobile or other wireless broadband usage at scale in 2010, more recent technological advances—sometimes considered in the context of fifth generation (5G) wireless services—have significantly improved

[10] *2013 Presidential Memorandum*.

[11] "…[W]e must ensure that Federal, State, local, tribal, and territorial governments are able to maintain mission critical capabilities that depend on spectrum today, as well as effectively and efficiently meet future requirements." *Id.* at introduction.

[12] *Fifth Interim Report* at 1.

[13] The latter amount was reduced by 18 megahertz since the *Fifth Interim Report* because the FCC eliminated the two band plans with clearing targets greater than 126 megahertz from consideration in the incentive auction. *See infra* p. 12 and note 41.

[14] Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, GN Docket No. 14-177, PP Docket No. 93-253, *Notice of Inquiry*, 29 FCC Rcd 13020 (2014) *available at* https://apps.fcc.gov/edocs_public/attachmatch/FCC-14-154A1.pdf (*Spectrum Frontiers NOI*).

the utility of these bands to support mobile broadband and other valuable wireless broadband services.[15]

Table 1—Federal, Non-Federal, and Shared Spectrum Bands Under Investigation				
Frequency Band	*Spectrum Made Available (megahertz)*	*Spectrum Identified and In Process (megahertz)*	*Spectrum Identified and Under Study (megahertz)*	*Spectrum for Potential Future Study (megahertz)*
Wireless Communications Service (WCS): 2305-2320 and 2345-2360 MHz	30			
H Block: 1915-1920 and 1995-2000 MHz	10			
Advanced Wireless Services AWS-4: 2000-2020 and 2180-2200 MHz	40			
AWS-3: 1695-1710, 1755-1780, and 2155-2180 MHz	65			
3.5 GHz Citizens Broadband Radio Service (CBRS): 3550-3650 MHz	100			
UHF TV Incentive Auction: 512-698 MHz		42-126		
1675-1680 MHz			5	
2020-2025 MHz			5	
5 GHz Unlicensed National Information Infrastructure (U-NII) U-NII-2B: 5350-5470 MHz			120	
5 GHz U-NII-4: 5850-5925 MHz			75	
1300-1390 MHz				90
1680-1695 MHz				15
2700-2900 MHz				200
2900-3100 MHz				200
3100-3550 MHz				450
Totals (megahertz):	**245**	**42-126**	**205**	**955**

[15] *See* Wheeler, Tom, FCC Chairman, *Leading towards Next Generation "5G" Mobile Services* (Aug. 3, 2015), *available at* https://www.fcc.gov/blog/leading-towards-next-generation-5g-mobile-services.

Advanced Wireless Services-3 (AWS-3)

In November 2014, the FCC began an auction of commercial licenses in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz (AWS-3) bands in accordance with rules it established in March 2014.[16] Provisions of the *AWS-3 Report and Order* established coordination requirements for temporary or permanent sharing between federal systems and new, licensed commercial wireless broadband systems as they enter the AWS-3 bands.[17] NTIA and the FCC released a Joint Public Notice in July 2014 that established a framework for the required coordination.[18]

During this reporting period, the FCC completed the AWS-3 auction, and NTIA, the FCC, and the federal agencies prepared for formal coordination between the new AWS-3 licensees and the federal agencies, to begin early in the first quarter of FY16. Making these bands available for commercial use represents a milestone in accelerating commercial access to bands with incumbent federal users through spectrum sharing arrangements. It also satisfied the requirements of the *Tax Relief Act* to make spectrum in the following bands available for services supporting commercial use:

- 15 megahertz between 1675-1710 MHz, to be identified by NTIA by February 2013
- 25 megahertz at 2155-2180 MHz
- An additional contiguous 15 megahertz to be identified by the FCC[19]

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[16] 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 (2014) *available at* https://apps.fcc.gov/edocs_public/attachmatch/FCC-14-31A1.pdf (*AWS-3 Report and Order*).

[17] *See id.* at ¶ 222. As described in the *Fourth Interim Report*, NTIA determined, based on Commerce Spectrum Management Advisory Committee (CSMAC) studies, that relocation of some federal systems from the 1695-1710 MHz and 1755-1780 MHz bands was not feasible because of technical or cost constraints; *see* NTIA, *Fourth Interim Progress Report on the Ten-Year Plan and Timetable and Plan for Quantitative Assessments of Spectrum Usage* at 12 (June 5, 2014) *available at* http://www.ntia.doc.gov/files/ntia/publications/fourth_interim_progress_report_final.pdf (*Fourth Interim Report*). In accordance with Commercial Spectrum Enhancement Act (CSEA) requirements, NTIA provided notification of this situation to the Chairmen and Ranking Members of the Senate Committee on Commerce, Science and Transportation; and the House Committee on Energy and Commerce. *See* 47 U.S.C. § 923(j)(2) (2013); Letters from Lawrence E. Strickling, Assistant Secretary for Communications and Information, U.S. Department of Commerce, to The Honorable John D. Rockefeller IV, Chairman, Senate Committee on Commerce, Science and Transportation, et al. (June 4, 2014) *available at* http://www.ntia.doc.gov/files/ntia/publications/ntia_notice_to_congress_per_47_usc_923j_re_1695_and_1755_sharing_final_06-04-2014.pdf.

[18] Coordination Procedures in the 1695-1710 MHz and 1755-1780 MHz Bands, GN Docket No. 13-185, *Joint Public Notice*, 29 FCC Rcd 8527 (2014) *available at* https://apps.fcc.gov/edocs_public/attachmatch/DA-14-1023A1_Rcd.pdf (*AWS-3 Coordination Procedures PN*). *See also Fifth Interim Report* at 7-8, describing preparations for the coordination process prior to October 2014.

[19] *Tax Relief Act* § 6401, 47 U.S.C. § 1451 (2013).

AWS-3 Auction

In October 2014, the FCC announced that 70 applicants were deemed qualified to bid on licenses in the AWS-3 auction, scheduled to begin that November.[20] Based on Commercial Spectrum Enhancement Act (CSEA) requirements that certain proceeds of the auction cover the estimated relocation or sharing costs of incumbent federal entities, the FCC set aggregate reserve prices as follows:

- $579,775,900 for licenses in the 1695-1710 MHz band.
- $5,033,163,300 for licenses in the paired 1755-1780/2155-2180 MHz bands.[21]

The AWS-3 auction began on November 13, 2014 and ended on January 29, 2015.[22] The net total winning bids for both the 1695-1710 MHz band and the paired 1755-1780/2155-2180 MHz bands substantially exceeded the respective reserve prices.[23] Thirty-one of the bidders won licenses, with total provisional net winning bids exceeding $41 billion.[24] The funds raised through the auction will support FirstNet and other Congressionally-identified priorities, including deficit reduction.

Coordination Between AWS-3 Licensees and Federal Incumbents

To facilitate coordination, NTIA and DOD began developing online "portals" through which licensees would be able to initiate coordination of sharing with federal agencies operating incumbent systems. NTIA's Institute for Telecommunication Sciences was establishing a portal for coordination in the 1695-1710 MHz band. The Department of Commerce, DOD, and the Department of Interior (DOI) were to begin accepting licensees' coordination requests via this portal in late 2015. Also in late 2015, DOD's portal was to begin support of coordination in the 1755-1780 MHz band with DOD incumbent systems and with those of DOI and the Department of Justice.[25] Other federal agencies that have operations in the 1755-1780 MHz band are

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[20] Auction of Advanced Wireless Services (AWS-3) Licenses; 70 Bidders Qualified to Participate in Auction 97, AU Docket No. 14-78, *Public Notice*, 29 FCC Rcd 13465 at ¶ 1 (2014) *available at* https://apps.fcc.gov/edocs_public/attachmatch/DA-14-1564A1.pdf.

[21] *See* 47 U.S.C. §§ 309(j)(8)(D), 923(g) (2013); Auction of Advanced Wireless Services (AWS-3) Licenses Scheduled for November 13, 2014; Notice and Filing Requirements, Reserve Prices, Minimum Opening Bids, Upfront Payments, and Other Procedures for Auction 97, AU Docket No. 14-78, *Public Notice*, 29 FCC Rcd 8386 at ¶¶ 184-188 (2014) *available at* https://apps.fcc.gov/edocs_public/attachmatch/DA-14-1018A1.pdf. The auctions of either or both the lower band and the paired bands would have been cancelled, had the aggregate winning bids not met the reserve price (or twice the reserve price in the case of the paired bands). *See id*. at ¶ 190.

[22] *Id.* at ¶ 1; Auction of Advanced Wireless Services (AWS-3) Licenses Closes; Winning Bidders Announced for Auction 97, AU Docket No. 14-78, *Public Notice*, 30 FCC Rcd 630 at ¶ 1 (2015) *available at* https://apps.fcc.gov/edocs_public/attachmatch/DA-15-131A1.pdf (*AWS-3 Auction Results PN*).

[23] *Id*. at ¶ 2.

[24] *Id*. at ¶ 1.

[25] *See AWS-3 Coordination Procedures PN* at 8536.

establishing their own processes to address licensees' coordination requests. While formal coordination was scheduled to begin in late 2015, NTIA and the FCC strongly encouraged licensees and incumbents to begin voluntary, non-binding coordination earlier to facilitate and expedite the formal coordination.[26]

Once the formal coordination period begins, NTIA and the FCC expect the federal incumbents to review formal coordination requests from the licensees and provide timely responses, unless they have agreed to other arrangements.[27] Licensees will initiate the process by formally requesting access through one of the portals, where applicable, or directly to the agencies operating incumbent systems. The coordination procedures require the federal point of contact to acknowledge receipt of the request within five calendar days and, within ten days, notify the AWS-3 licensee as to whether the agency found the request to be complete or incomplete.[28]

Unless the federal agency finds the request to be incomplete, or the agency and the AWS-3 licensee agree to a different timeline, the coordination procedures require the agency to provide the licensee a letter responding to the formal request within 60 days after the deadline for the notice of completeness.[29] Federal agency responses to the coordination request could be concurrence, partial concurrence with operating conditions that specify the terms in which the licensee may begin operations, or denial of the request.[30] Licensees and agencies are working collaboratively to ensure a smooth and successful coordination process.

3.5 GHz Citizens Broadband Radio Service

Building on its rulemaking activities initiated in 2012, the FCC adopted rules in April 2015 for the Citizens Broadband Radio Service (CBRS), making the 3550-3700 MHz (3.5 GHz) band available for shared wireless broadband use.[31] The rules create a three-tiered authorization

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[26] *Id*. at 8536-37. Federal incumbents were "not obligated to entertain formal coordination requests until nine months after the date of the auction closing Public Notice," which was the January 30, 2015 date of the *AWS-3 Auction Results PN*. In support of these informal discussions, CTIA—The Wireless Association®, the Competitive Carriers Association ("CCA"), and Comsearch hosted an informal "AWS-3 Frequency Coordination Symposium" on June 4, 2015, bringing potential AWS-3 licensees and federal agency representatives together to discuss data acquisition, analysis procedures notification processes, and time frames for complying with provisions of the *AWS-3 Coordination Procedures PN*.

[27] *Id.*

[28] *Id*. at 8537.

[29] *Id.*

[30] *Id*. at 8538. *See id*. at 8539-40 for details of procedures for licensee options after receiving this federal agency notification, and for resolutions of disputes between the agency and the licensee.

[31] Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, GN Docket No. 12-354, *Report and Order and Second Further Notice of Proposed Rulemaking*, 30 FCC Rcd 3959 (2015) *available at* https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-47A1.pdf (*3.5 GHz R&O and Second FNPRM*). The FCC's CBRS rules became effective July 23, 2015. *See* Shared Commercial Operations in the 3550–

framework—with incumbent users in the top tier—and require that CBRS users in the band operate on a non-interference basis with respect to the incumbents.[32] These incumbent users include federal high-powered fixed and mobile radar systems on ground-based, shipborne, and airborne platforms; and non-federal fixed-satellite service (FSS) operations.[33]

The use of a database-driven Spectrum Access System (SAS) will enable this innovative model, consisting of incumbent users in the Incumbent Access tier, licensed CBRS operators in the Priority Access (PA) tier, and the General Authorized Access (GAA) tier. Licenses for the PA tier authorize the use of a 10 megahertz channel in a single census tract for three years. The SAS provides the PA tier protection from interference from users in the GAA tier, and protects the Incumbent Access tier systems from interference from either the PA or GAA tier. The FCC will assign licenses for the PA tier in up to 70 megahertz of the 3550-3650 MHz portion of the band. The rules allow GAA users to operate throughout the 3550-3700 MHz band, but with no interference protection from other CBRS users. GAA users may operate across at least 80 megahertz, and may access unused spectrum in PA license areas.

NTIA, the FCC, and DOD have been participating in a joint working group since May 2014 to reduce constraints on new wireless broadband operations while protecting the incumbent federal radar operations. Of particular concern were large exclusion zones in coastal areas (to mitigate interference between CBRS systems and shipborne radars) and around ground-based radars.[34] To reduce the exclusion zones and maximize the spectrum available for commercial use, the group employed a new analysis model that leveraged Geographic Information System data to increase the fidelity of the assessment of potential interference to federal systems. The analysis based on this model significantly reduced the size of the exclusion zones necessary to protect federal operations, increasing the overall market access for broadband systems.

In a March 2015 letter to the FCC, NTIA proposed coastal exclusion zones based on the revised analysis that encompassed 77 percent less geographic area than the original zones.[35] The letter also recommended the use of an Environmental Sensing Capability (ESC) in the vicinity of

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3650 MHz Band, GN Docket No. 12-354, *Final Rule*, *published at* 80 Fed. Reg. 36164 (June 23, 2015) *available at* http://www.gpo.gov/fdsys/pkg/FR-2015-06-23/pdf/2015-14494.pdf (*3.5 GHz Final Rule*).

[32] *See 3.5 GHz R&O* at ¶ 45. Broadband CBRS systems will use low-power small cells to facilitate spectral reuse and sharing; *3.5 GHz Final Rule* at 36166.

[33] *Id*. at ¶¶ 15-16.

[34] The technical assumptions in NTIA's *Fast Track Report* formed the basis for these protection zones; *see* 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* at Appendices D and E (Oct. 2010) *available at* http://www.ntia.doc.gov/files/ntia/publications/fasttrackevaluation_11152010.pdf.

[35] Letter from Paige R. Atkins, Associate Administrator, Office of Spectrum Management, NTIA, to Julius P. Knapp, Chief, Office of Engineering and Technology, FCC at 5-6 (Mar. 24, 2015) *available at* http://www.ntia.doc.gov/fcc-filing/2015/ntia-letter-fcc-commercial-operations-3550-3650-mhz-band (*NTIA 3.5 GHz Letter*).

the exclusion zones to detect signals from federal radars and provide pertinent information to the SAS. The SAS would then direct PA licensees and GAA users to frequencies that would enable the CBRS systems to operate within the exclusion zones.[36] In June 2015, NTIA published a report detailing the analyses and methodology behind the new exclusion zones.[37] This work represented a critical step toward opening the 3.5 GHz band for shared wireless broadband use while protecting federal users.

The *3.5 GHz Second FNPRM* also sought comment on other issues, including how to define the area of a PA license that is in use, and issues with respect to protections for incumbent commercial FSS operations.[38] Consistent with the *3.5 GHz R&O*, the FCC also planned to solicit proposals from prospective SAS Administrators and ESC operators, and to conduct a comprehensive review of the proposals and systems. The FCC expected to issue a Public Notice requesting proposals from entities interested in administering an SAS—for a five-year term—by the end of calendar year 2015.[39] The Public Notice was also expected to describe a phased approach to implement the SAS and ESC, and an approval process that the FCC will oversee and administer in consultation with NTIA and DOD.

Incentive Auction

In August 2015, the FCC announced that bidding in the incentive auction, which will make additional low band spectrum available for wireless broadband providers, would begin on March 29, 2016. The incentive auction will consist of a reverse auction, in which broadcasters voluntarily relinquish some or all of their spectrum rights, followed by a forward auction of new, flexible-use licenses suitable for wireless broadband services.[40] Following the reverse auction, the FCC will repack the remaining broadcast television bands into a smaller part of the UHF band, making contiguous spectrum available for the flexible-use licenses for the forward auction. The FCC will use the proceeds of the forward auction to pay broadcasters that relinquish usage rights in the reverse auction.

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[36] *See 3.5 GHz R&O* at ¶ 33.

[37] NTIA, *3.5 GHz Exclusion Zone Analyses and Methodology*, Technical Report TR-15-517 (June 2015) *available at* http://www.its.bldrdoc.gov/publications/2805.aspx.

[38] *See 3.5 GHz Second FNPRM* at ¶¶ 418, *et seq.*

[39] Wireless Telecommunications Bureau Announces Comment Dates for 3.5 GHz Second FNPRM and Upcoming Releases in GN Docket No. 12-354, GN Docket No. 12-354, *Public Notice*, 30 FCC Rcd 6482, 6482-83 (2015) *available at* https://apps.fcc.gov/edocs_public/attachmatch/DA-15-750A1.pdf.

[40] Comment Sought on Competitive Bidding Procedures for Broadcast Incentive Auction 1000, Including Auctions 1001 and 1002, AU Docket No. 14-252, GN Docket No. 12-268, *Public Notice*, 29 FCC Rcd 15750 at ¶¶ 1-2 (2014) *available at* https://apps.fcc.gov/edocs_public/attachmatch/FCC-14-191A1.pdf (*Incentive Auction Procedures PN*). Additional low band spectrum (in the 600 MHz frequency range) will allow providers to fill coverage gaps in rural areas and provide more reliable indoor coverage in urban areas. Letters from Tom Wheeler, Chairman, Federal Communications Commission, to The Honorable Angus King, United States Senate, et al. (Aug. 20, 2015) *available at* http://transition.fcc.gov/Daily_Releases/Daily_Business/2015/db0902/DOC-335146A1.pdf.

The amount of spectrum repurposed for mobile broadband services—the "clearing target"—will depend on the number of UHF channels broadcasters make available. Clearing the minimum of seven channels would make 42 megahertz available for repurposing, while clearing the maximum of 21 channels would make 126 megahertz available.[41] The design of these reverse and forward auctions allows market forces to choose between competing commercial uses for the spectrum, consistent with the FCC's central objective for the incentive auction.[42]

The FCC took a number of steps to finalize the rules and procedures in advance of the auction. Among these, it defined what constitutes a commercial wireless licensee's commencement of operation,[43] specified bidding procedures,[44] accommodated wireless microphone users,[45] and amended rules to maximize unlicensed white space device access to spectrum in the 600 MHz and broadcasting bands, including access to vacant channels.[46]

5 GHz Unlicensed (U-NII) Services

Unlicensed National Information Infrastructure (U-NII) devices currently operate in four frequency bands in the 5 GHz range, totaling 555 megahertz. Using wideband digital modulation techniques, these devices provide a wide array of high-data-rate mobile and fixed

[41] Since the *Fifth Interim Report*, the FCC eliminated the two band plans with clearing targets greater than 126 megahertz from consideration in the incentive auction: "Pursuant to joint planning between the Commission and Industry Canada, and in light of Industry Canada's decision to repurpose the 600 MHz Band, the 138 and 144 megahertz clearing targets will not be considered in order to better harmonize the 600 MHz Band Plan between the two countries." Application Procedures for Broadcast Incentive Auction Scheduled to Begin on March 29, 2016, AU Docket No. 14-252, GN Docket No. 12-268, WT Docket No. 12-269, *Public Notice*, 30 FCC Rcd 11034 at ¶ 78 n. 135 (2015) *available at* https://apps.fcc.gov/edocs_public/attachmatch/DA-15-1183A1.pdf (citations omitted). *See also* Statement of Intent Between the Federal Communications Commission of the United States of America and the Department of Industry of Canada Related to the Reconfiguration of Spectrum Use in the UHF Band for Over-the-Air Television Broadcasting and Mobile Broadband Services, U.S.–Can., Aug. 11, 2015, *available at* https://transition.fcc.gov/ib/sand/agree/files/PASIIC.pdf.

[42] *Incentive Auction Procedures PN* at ¶ 37.

[43] Expanding the Economic and Innovation Opportunities of Spectrum through Incentive Auctions, GN Docket No. 12-268, *Report & Order*, 30 FCC Rcd 12025 at ¶¶ 8-13 (2015) *available at* https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-140A1.pdf (*Incentive Auction R&O*).

[44] *See Incentive Auction Procedures PN*.

[45] *See* Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37, ET Docket No. 14-165, GN Docket No. 12-268, *Report & Order*, 30 FCC Rcd 9551 at ¶¶ 94-101, 136-144 (2015) *available at* https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-99A1.pdf (*Part 15 White Space R&O*); *Incentive Auction Procedures PN* at ¶ 32; Promoting Spectrum Access for Wireless Microphone Operations, GN Docket Nos. 14-166, 12-268, *Report and Order*, 30 FCC Rcd 8739 (2015), *available at* https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-100A1.pdf.

[46] *See Part 15 White Space R&O*; Amendment of Parts 15, 73 and 74 of the Commission's Rules to Provide for the Preservation of One Vacant Channel in the UHF Television Band For Use By White Space Devices and Wireless Microphones, MB Docket No. 15-146, *Notice of Proposed Rulemaking*, 30 FCC Rcd 6711 at ¶ 1 (2015) *available at* https://apps.fcc.gov/edocs_public/attachmatch/FCC-15-68A1.pdf.

communications for individuals, businesses, and institutions.[47] Applications in these bands include broadband services offered by Wireless Internet Service Providers (WISPs), particularly in rural areas.[48]

The 2012 *Tax Relief Act* directed NTIA, in consultation with DOD and other affected agencies, to evaluate spectrum sharing technologies and determine the risk to federal users of allowing U-NII devices to operate in the 5350-5470 MHz (U-NII 2B) and 5850-5925 MHz (U-NII 4 or "5.9 GHz") bands.[49] In 2013, the FCC proposed making these two bands, totaling 195 megahertz, available for unlicensed use on a shared basis.[50]

NTIA's *Fifth Interim Progress Report* described extensive 5350-5470 MHz sharing studies NTIA conducted, in cooperation with federal and commercial interests and the FCC. The studies addressed compatibility between U-NII devices and ground-based, airborne, shipborne, and space-based radar systems operating in the band.[51] During this reporting period, additional studies examined industry proposals to employ dedicated listening devices or dynamic databases, in conjunction with Dynamic Frequency Selection (DFS) detect-and-avoid technology, to protect federal operations from potential interference. NTIA believes that the effective implementation of such technologies holds promise for making additional spectrum available for unlicensed use, while protecting critical radar operations. As industry representatives provide additional information and refine their sharing proposals, NTIA, the FCC, and affected federal agencies will continue to collaborate with industry in conducting studies to validate technologies to mitigate interference from unlicensed devices.

In the 5.9 GHz band, NTIA and the FCC, working with the Department of Transportation (DOT), continue to assess the feasibility of sharing between U-NII devices and DOT's Dedicated Short Range Communications (DSRC) devices for Intelligent Transportation Systems (ITS). DOT, in coordination with NTIA, released a draft 5.9 GHz test plan in August 2015 for

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[47] *See* Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band, ET Docket No. 13-49, *First Report and Order*, 29 FCC Rcd 4127 at ¶ 1 (2014) *available at* https://apps.fcc.gov/edocs_public/attachmatch/FCC-14-30A1.pdf.

[48] *See* Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band, ET Docket No. 13-49, *Notice of Proposed Rulemaking*, 28 FCC Rcd 1769 at Footnote 12 (2013) *available at* https://apps.fcc.gov/edocs_public/attachmatch/FCC-13-22A1.pdf (*5 GHz NPRM*).

[49] *Tax Relief Act* § 6406, 47 U.S.C. § 1453 (2013). *See 5 GHz NPRM* at ¶ 14 for the FCC's designators for the existing and proposed U-NII bands.

[50] *See id*. at ¶ 2.

[51] *Fifth Interim Report* at 11-12. *See infra* at 17, describing U.S. preparations for WRC-15 regarding potential modifications to the *ITU Radio Regulations* to support worldwide terrestrial mobile broadband in these and other frequency bands; ITU, *Radio Regulations* (Edition of 2012) *available at* http://www.itu.int/pub/R-REG-RR/en (*ITU Radio Regulations*).

stakeholder comment.[52] The proposed testing would characterize the existing radio frequency signal environment and the impact that U-NII devices, operating in the 5.9 GHz band and adjacent bands, would have on DSRC operations in this complex environment. In order to facilitate direct interaction and cooperation between industry and government stakeholders, which will be necessary for the development of feasible sharing solutions in the 5.9 GHz band, NTIA, DOT, and the FCC plan to host stakeholder meetings.

Spectrum Frontiers

As part of its continued efforts to identify spectrum to meet the growing demand for wireless broadband, the FCC released the *Spectrum Frontiers NOI* in October 2014, examining the use of frequency bands above 24 GHz. Recent technological advances have led the commercial mobile industry to consider these bands in the millimeter wave range, spectrum it once generally deemed unattractive or unusable for wireless broadband, including mobile broadband.[53] The NOI sought comment on technologies that might enable mobile services above 24 GHz, specific bands that would be suitable, methodologies for managing interference among new and incumbent uses (including satellite), and the appropriate licensing and authorization schemes.[54]

Wireless broadband networks will likely require a diversity of low, mid, and high band spectrum, both licensed and unlicensed, to adequately support the breadth of anticipated applications.[55] Accordingly, NTIA will continue to work closely with the FCC to make higher bands available to help enable industry innovation and maintain U.S. leadership in advanced wireless technologies.

Related Activities

Quantitative Assessments of Spectrum Usage

The *2013 Presidential Memorandum* included provisions intended to spur NTIA and the federal agencies to identify frequency bands with the greatest potential for sharing with non-federal users.[56] In June 2014, NTIA published a *Plan for Quantitative Assessments of Spectrum*

[52] Intelligent Transportation Systems—Joint Program Office, *DSRC–Unlicensed Device Test Plan*, Version 3.5.3 (Aug. 2015) *available at* http://its.dot.gov/connected_vehicle/pdf/DSRC_TestPlanv3.5.3.pdf.

[53] *Spectrum Frontiers NOI* at ¶ 1.

[54] *Id*. at ¶ 16.

[55] *See, e.g.*, Comments of CTIA—The Wireless Association in GN Docket No. 14-177 at 2 (Jan. 28, 2016), available at http://www.ctia.org/docs/default-source/fcc-filings/150115-filed-ctia-5g-noi-comments.pdf?sfvrsn=0.

[56] The provisions directed NTIA to develop, for inclusion in its *Fourth Interim Report*, a plan directing federal agencies to provide quantitative assessments of their "actual use of spectrum" in certain frequency bands; *2013 Presidential Memorandum* at § 3(a).

Usage for federal radio systems in five frequency bands (shown in Table 2) that met the criteria from the *2013 Presidential Memorandum*.[57]

Table 2—Spectrum Bands Subject to Quantitative Assessments	
Frequency Band (MHz)	Amount (megahertz)
1300-1390	90
1675-1695	20
2700-2900	200
2900-3100	200
3100-3550	450
Total (megahertz):	**960**

Upon issuing the plan, NTIA worked with the agencies to conduct quantitative assessments of their spectrum use in these bands. To supplement the metrics and parameters available in the Government Master File, NTIA requested that the agencies submit additional information (e.g., area of operation, time of operation) for their systems. NTIA worked with agency representatives to ensure a consistent and accurate methodology is used to determine the coverage area and the time of use for each system. NTIA developed an automated capability to compute and display spectrum usage contours for terrestrial transmit and receive stations, and applied this capability to the agencies' radio systems, using the updated metrics and parameters the agencies had provided.[58]

The quantitative assessments are an input into selecting frequency bands for further detailed feasibility studies. To ensure transparency, NTIA intends to work with the PPSG and the White House Spectrum Policy Team to prepare for public release, to the extent consistent with law, a summary of the quantitative assessments. NTIA and the Spectrum Policy Team will develop "any appropriate recommendations regarding the possible availability of spectrum in the subject bands for innovative and flexible commercial uses, including broadband, taking into account factors such as the nature of the federal systems in the bands and the extent to which those systems occupy and use the bands."[59]

[57] *Fourth Interim Report* at Appendix A.

[58] NTIA also authorizes transmit stations for systems that operate across large areas such as statewide, regional, in the conterminous United States, or the entire United States and Possessions (US&P). Spectrum usage contours are not generated for these transmit stations; however, they are accounted for in the frequency and time usage components of the quantitative assessments.

[59] *See 2013 Presidential Memorandum* at § 3(b). Section 1 (a) of the *2013 Presidential Memorandum* established the Spectrum Policy Team to work with NTIA to implement the memorandum and to monitor the advances in spectrum sharing policies and technologies. It is co-chaired by the Chief Technology Officer and the Director of the National Economic Council, or their designees, and includes representatives from the Office of Management and Budget (OMB), the National Security Staff, and the Council of Economic Advisors.

International Activities

The Radiocommunication Sector of the International Telecommunication Union (ITU-R) scheduled WRC-15 for November 2-27, 2015 in Geneva, Switzerland. WRC-15 Agenda Item 1.1, International Mobile Telecommunications (IMT) below 6 GHz, specifically addresses mobile broadband spectrum issues. Participants were expected to decide whether and how to modify frequency allocations in the *ITU Radio Regulations* to support worldwide terrestrial mobile broadband in particular frequency bands below 6 GHz.

In preparation for WRC-15, U.S. representatives participated in the second session of the Conference Preparatory Meeting in March–April 2015 to finalize, consolidate, and publish technical studies in support of WRC-15 agenda items. Leading up to WRC-15, the primary U.S. focus was to finalize, and build international support for, proposals for changes to international frequency allocations to make more than 600 megahertz of additional spectrum available for 4G wireless broadband in North America. With some conditions and exceptions, the United States was proposing co-primary mobile service allocations, along with identification for IMT, at 470-698 MHz, 1427-1518 MHz, and 3400-3700 MHz, while ensuring protection of incumbent services in the bands. The United States was not supporting co-primary mobile service allocations in numerous other bands.[60] The United States was also proposing that WRC-19 include further study of potential unlicensed spectrum in the 5 GHz range and High Altitude Platform Systems.[61]

Proposed Model City for Demonstrating and Evaluating Advanced Spectrum Sharing Technologies

The *2010 Presidential Memorandum* directed NTIA, in cooperation with the National Institute of Standards and Technology, the National Science Foundation, and federal agencies, to "create and implement a plan to facilitate research, development, experimentation, and testing by researchers to explore innovative spectrum-sharing technologies, including those that are secure and resilient.[62] Subsequently, in July 2012, the President's Council of Advisors on Science and Technology (PCAST) recommended the creation of a "Test City…to support the development of the policies, underlying technologies, and system capabilities required to support dynamic spectrum sharing."[63] On July 11, 2014, NTIA and the FCC issued a Joint Public Notice seeking

[60] The United States does not plan to identify the 1427-1518 MHz band for IMT domestically, due to extensive federal and non-federal, safety-related flight test telemetry operations in the band.

[61] NTIA has published approved U.S. proposals for WRC-15 at http://www.ntia.doc.gov/page/us-proposals.

[62] *2010 Presidential Memorandum* at § 3.

[63] PCAST, Report to the President: *Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth* at xiv, Recommendation 6.1 (July 20, 2012) *available at* http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf.

public comment on the establishment of an urban test city (or Model City) that would support rapid experimentation and development of policies, underlying technologies, and system capabilities for advanced, dynamic spectrum sharing.[64]

Building on the responses to the *Model City Public Notice*, NTIA and the FCC conducted a roundtable on January 22, 2015 to further explore goals and opportunities for a Model City program, and to plan for a Model City workshop.[65] NTIA and the FCC conducted a Workshop on April 15-16, 2015, with about 100 stakeholders from industry, government, and academia.[66] Participants discussed various aspects of governance, models for execution, funding models, process issues, state-of-the-art technologies that could be tested in a Model City, and case studies of prior collaborative testing exercises and data handling issues. Many cities expressed interest in forming Model Cities. NTIA and the FCC continue to explore next steps and will work with interested cities and stakeholders in executing the concepts developed during the workshop.

ACTIVITIES FOR THE NEXT TWELVE MONTHS

For the period ending September 2016, NTIA and the FCC, in collaboration with federal and non-federal stakeholders, will continue to implement the *2010 Presidential Memorandum*, the 2012 *Tax Relief Act*, and the *2013 Presidential Memorandum* in order to provide additional spectrum for wireless broadband services while protecting incumbent users. Specifically:

- NTIA and the FCC will help ensure timely and successful transition of the 1695-1710 MHz and 1755-1780 MHz bands to accommodate AWS-3 licensees.
- The FCC will conduct an incentive auction in the 600 MHz UHF band, making up to 126 megahertz of additional spectrum available for wireless broadband and raising additional funds for the U.S. Treasury.
- NTIA and the FCC will continue coordinating studies to find solutions for successful sharing between unlicensed devices and federal and non-federal incumbents in the proposed 5350-5470 MHz and 5850-5925 MHz U-NII bands.
- The FCC, in coordination with NTIA and federal agencies, will continue to pursue opening higher-frequency bands through its *Spectrum Frontiers* proceeding to enable

[64] The Federal Communications Commission and the National Telecommunications and Information Administration: Model City for Demonstrating and Evaluating Advanced Spectrum Sharing Technologies, ET Docket No. 14-99, *Public Notice*, 29 FCC Rcd 8242 (July 11, 2014) *available at* https://apps.fcc.gov/edocs_public/attachmatch/DA-14-981A1_Rcd.pdf (*Model City Public Notice*).

[65] NTIA, *Supporting Wireless Innovation Through a "Model City"* (Feb. 10, 2015) *available at* http://www.ntia.doc.gov/blog/2015/supporting-wireless-innovation-through-model-city.

[66] The FCC published a video record of the workshop, along with links to presentation materials, online at http://www.fcc.gov/events/fcc-and-ntia-announce-workshop-model-city-program.

future wireless broadband uses, including mobile broadband, and to help maintain U.S. leadership in the next generation of wireless.

- The FCC will consider, in coordination with NTIA and DOD, proposals for an Environmental Sensing Capability and a Spectrum Access System to facilitate sharing between new CBRS users in the 3.5 GHz band and federal and non-federal incumbents, including DOD radar systems.
- Working with NTIA, the federal agencies will complete the quantitative assessments mandated in the *2013 Presidential Memorandum*, and NTIA will coordinate with the Spectrum Policy Team to release a publicly available summary.
- Working with the Department of State and federal and non-federal interests, NTIA and the FCC were to advocate, during WRC-15, the U.S. positions regarding modifications to international frequency allocations to accommodate mobile broadband services, advocate that further consideration of such actions be an integral part of WRC-19, and subsequently will initiate studies to formulate the U.S. positions going into WRC-19.
- NTIA and the FCC will continue to work with interested cities and stakeholders to establish Model Cities for demonstrating and evaluating advanced spectrum sharing technologies.

CONCLUSION

NTIA and the FCC, together with the federal agencies in the PPSG, are continuing to work diligently toward achieving the goals of the *2010 Presidential Memorandum* through implementation of the *Ten-Year Plan*, applicable provisions of the *Tax Relief Act*, and the *2013 Presidential Memorandum*, as well as ongoing FCC rulemaking proceedings. Activities for the next 12 months will focus on transition of operations in the AWS-3 bands, development of new capabilities to fully implement sharing in the 3.5 MHz band, auction of 600 MHz UHF TV band frequencies, validation of proposed sharing approaches in the 5 GHz bands, identification of spectrum at higher frequencies for mobile broadband and other flexible uses, further maturity of a Model City program, and consideration of additional frequency bands for study toward our goal of making at least 500 megahertz of spectrum available for commercial broadband wireless services by 2020.