

Before the
Federal Communications Commission
Washington, D.C. 20554

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| In the Matter of |) | |
| |) | |
| Amendment of Part 27 of the Commission’s Rules to Govern the Operation of Wireless Communications Services in the 2.3 GHz Band |) | WT Docket No. 07-293 |
| |) | |
| Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band |) | IB Docket No. 95-91 GEN Docket No. 90-357 RM-8610 |

**REPORT AND ORDER
AND
SECOND REPORT AND ORDER**

Adopted: May 20, 2010

Released: May 20, 2010

By the Commission:

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I. INTRODUCTION

1. By our actions today, we make available an additional 25 megahertz of spectrum for mobile broadband service in much of the United States, while protecting adjacent satellite radio, aeronautical mobile telemetry, and deep space network operations. Although the current technical rules for Wireless Communications Service (WCS) in the 2.3 GHz band effectively limit terrestrial operations to fixed services, we find today that these technical rules can be changed without risking harmful interference to neighboring operations, and that these changes will enable licensees to provide mobile broadband services in 25 megahertz of the WCS band. To ensure that the promise of mobile broadband is realized, we adopt new build-out requirements for WCS licensees. In addition, to make possible high-quality satellite radio services to the American public, we adopt rules governing the use of terrestrial repeaters by Satellite Digital Audio Radio Service (SDARS) licensees.

2. The current Part 27 rules preclude WCS licensees from providing mobile broadband services, and the current Part 25 rules do not provide technical rules or a licensing regime for SDARS terrestrial repeaters, which are currently authorized via special temporary authority on a non-interference basis. In the Report and Order in WT Docket No. 07-293, we adopt final rules for the WCS that will modify the technical parameters governing the operation of WCS mobile and portable devices and thereby provide WCS licensees with the ability to offer mobile broadband services, while limiting the potential for harmful interference to incumbent services operating in adjacent bands. In the Second Report and Order in IB Docket No. 95-91, we adopt technical rules governing the operation of SDARS terrestrial repeaters that will not impede their deployment or function, but will limit the potential for harmful interference to adjacent bands' WCS spectrum users, and adopt a blanket-licensing regime for SDARS repeaters to promote their flexible deployment.

3. Specifically, the Report and Order we adopt in WT Docket No. 07-293 establishes a regulatory framework for the co-existence of SDARS and WCS licensees in the 2305-2360 MHz (2.3 GHz) frequency band.

- The Report and Order modifies the rules governing WCS operations to allow the operation of mobile and portable¹ stations at power levels of up to 250-milliwatts (mW) average equivalent isotropically radiated power (EIRP) per 5 megahertz in WCS Blocks A and B and in the portions of WCS Blocks C and D that are separated by 2.5 megahertz from the edges of the SDARS band at 2320-2345 MHz (*i.e.*, 2305-2317.5 and 2347.5-2360 MHz). WCS mobile and portable devices are not permitted to operate in the 2.5-megahertz portions of the WCS C and D blocks closest to the SDARS band (*i.e.*, 2317.5-2320 and 2345-2347.5 MHz). WCS mobile and portable devices using time division duplex (TDD)² technology are limited to a duty cycle³ of 38 percent. WCS mobile and portable devices using frequency division duplex (FDD)⁴ technology are limited to a duty cycle of 25 percent in the lower WCS A and B blocks and 12.5 percent in the 2.5-megahertz portion of the WCS C block furthest from the SDARS band edge, and are restricted to transmitting in the 2305-2317.5 MHz band. WCS mobile and portable devices must also employ automatic transmit power control (ATPC) when operating so the devices use the minimum power necessary for successful communications.⁵

¹ Under the Commission's rules for radio frequency (RF) exposure evaluation, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. 47 C.F.R. § 2.1091. A portable device is defined as a transmitting device where the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. 47 C.F.R. § 2.1093.

² TDD is a radio communications technology where a single radio frequency band is divided into timeslots and used for uplink (*i.e.*, user device) and downlink (*i.e.*, base station) transmissions.

³ Duty cycle (also known as duty factor) is the percentage of a transmission frame that a WCS user device uses to transmit uplink information to the base station (*i.e.*, the "on time" of a WCS user device's transmitter in a given transmission frame).

⁴ FDD is a radio communications technology where two separate radio frequency bands are used for uplink and downlink transmissions.

⁵ ATPC is a feature of a digital microwave radio link that adjusts the transmitter output power based on the varying signal level at the receiver. ATPC allows the transmitter to operate at less than maximum power for most of the time, thereby minimizing the potential for intra and inter-service interference; when fading conditions occur, transmit power is increased as needed until the maximum is reached. An ATPC equipped system has several potential advantages over a fixed transmit power system, including less transmitter power consumption, longer amplifier component life, and reduced interference potential to other microwave radio systems. *See* National Spectrum Managers Association Recommendation WG 18.91.032 Automatic Transmit Power Control (ATPC) at 1,

(continued...)

- Additionally, under the new rules we adopt today, WCS mobile and portable devices' out-of-band emissions (OOBE), as measured over a 1-megahertz resolution bandwidth,⁶ must be attenuated below the transmitter power P by a factor not less than $43 + 10 \log(P)$ decibels (dB) on all frequencies between 2305-2317.5 MHz and on all frequencies between 2347.5-2360 MHz that are outside the licensed band of operation, not less than $55 + 10 \log(P)$ dB in the 2320-2324/2341-2345 MHz bands, not less than $61 + 10 \log(P)$ dB in the 2324-2328/2337-2341 MHz bands, not less than $67 + 10 \log(P)$ dB in the 2328-2337 MHz band, where P is the transmitter output power in Watts. OOBE must also be attenuated by a factor of not less than $43 + 10 \log(P)$ dB in the 2300-2305 and 2360-2365 MHz bands, not less than $55 + 10 \log(P)$ dB in the 2296-2300 MHz band, not less than $61 + 10 \log(P)$ dB in the 2292-2296 MHz band, not less than $67 + 10 \log(P)$ dB in the 2288-2292 MHz band, and not less than $70 + 10 \log(P)$ dB below 2288 MHz and above 2365 MHz.
- WCS base and fixed stations in WCS Blocks A and B (*i.e.*, 2305-2315 and 2350-2360 MHz) will be permitted to operate with up to 2 kilowatts (kW) average EIRP per 5 megahertz with a 13 dB peak-to-average power ratio (PAPR). Base and fixed stations in WCS Blocks C and D (*i.e.*, 2315-2320 and 2345-2350 MHz) are limited to the 2 kW per 5 megahertz peak EIRP limit currently specified in our Rules. WCS base stations supporting FDD mobile and portable operations are restricted to transmitting in the 2345-2360 MHz band. WCS base and fixed stations' OOBE must be attenuated below the transmitter power P by a factor of not less than $43 + 10 \log(P)$ dB on all frequencies between 2305-2320 MHz and on all frequencies between 2345-2360 MHz that are outside the licensed band of operation, not less than $75 + 10 \log(P)$ dB on all frequencies in the 2320-2345 MHz band, not less than $43 + 10 \log(P)$ dB in the 2300-2305 and 2360-2362.5 MHz bands, not less than $55 + 10 \log(P)$ dB in the 2362.5-2365 MHz band, not less than $70 + 10 \log(P)$ dB in the 2287.5-2300 MHz and 2365-2367.5 MHz bands, not less than $72 + 10 \log(P)$ dB in the 2285-2287.5 and 2367.5-2370 MHz bands, and not less than $75 + 10 \log(P)$ dB below 2285 MHz and above 2370 MHz.

The Report and Order also establishes enhanced performance requirements to ensure that WCS licensees use the spectrum intensively in the public interest.

- For mobile and point-to-multipoint services, licensees must serve 40 percent of a license area's population within 42 months, and 75 percent within 72 months. For fixed point-to-point services, licensees must construct and operate 15 point-to-point links per million persons in a license area within 42 months, and 30 links within 72 months. Licensees will not be required to satisfy submarket construction requirements.
- In those license areas where licensees must coordinate with aeronautical mobile telemetry (AMT) receive sites to serve a significant percentage of a market's total population, we establish alternative requirements for mobile and point-to-multipoint services. Specifically, affected licensees must serve 25 (rather than 40) percent of the population within 42 months, and 50 (rather than 75) percent within 72 months.

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available at <http://www.nema.org/recommendation/WG18-91-032.pdf> (last visited Oct. 21, 2009). In our Part 27 Rules, we currently require a WCS portable device operating in the 2305-2315 MHz band to employ ATPC. 47 C.F.R. § 27.53(a)(9)(iv).

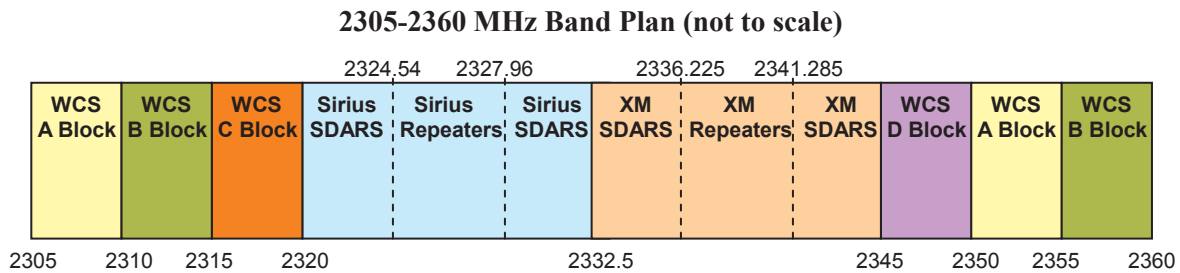
⁶ Consistent with our existing Rules for the 2.5 GHz band in Section 27.53(m)(6), however, in the 1-megahertz bands immediately outside and adjacent to the WCS frequency blocks (*i.e.*, at 2304-2305 and 2360-2361 MHz), a resolution bandwidth of at least 1 percent of the emission bandwidth of the fundamental emission of the transmitter may be employed, provided the measured power is integrated over a 1-megahertz bandwidth.

4. The Second Report and Order in IB Docket No. 95-91 provides permanent rules for the operation of SDARS terrestrial repeaters, including establishing a blanket licensing regime for repeaters operating up to 12-kW average EIRP. As part of this Second Report and Order, we also deny the petitions for reconsideration of the *1997 SDARS Order*⁷ filed by the Consumer Electronics Manufacturing Association (CEMA)⁸ and the Cellular Phone Taskforce.⁹

II. BACKGROUND

5. A principal challenge in establishing a permanent regulatory framework for the 2305-2360 MHz frequency band has been the difficulty of resolving potential interference among the proposed operations of SDARS and WCS licensees in a manner that will permit the two services to co-exist. These interference concerns arise from the fact that these two very different services – one chiefly satellite-based and the other terrestrial-based – are allocated to adjacent frequency bands, with no guard bands separating the services.

6. Specifically, the SDARS and WCS services occupy 55 megahertz of spectrum from 2305-2360 MHz, in a portion of the radio frequency (RF) spectrum frequently referred to as the “S-band.” SDARS occupies the center portion of this band, 2320-2345 MHz, and this spectrum is divided evenly between two separate, but co-owned, SDARS networks, Sirius and XM.¹⁰ The WCS service occupies frequencies on either side of the SDARS allocation and consists of six blocks of 5 megahertz each in the 2305-2320 and 2345-2360 MHz bands.¹¹ The figure below shows the spectrum allocations in the 2305-2360 MHz bands.



⁷ Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band, *Report and Order, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking*, 12 FCC Rcd 5754 (1997) (“*SDARS Order and FNPRM*”).

⁸ Petition for Reconsideration of the Consumer Electronics Manufacturing Association, IB Docket No. 95-91 (Mar. 27, 1997) (“*CEMA Reconsideration Petition*”).

⁹ Petition for Partial Reconsideration of the Cellular Phone Taskforce, IB Docket No. 95-91 (Apr. 9, 1997) (“*Cellular Phone Taskforce Reconsideration Petition*”).

¹⁰ The 2320-2332.5 MHz band was originally assigned to Sirius Satellite Radio Inc. (Sirius) (formerly, Satellite CD Radio, Inc.), and the 2332.5-2345 MHz band was originally assigned to XM Radio Inc. (XM) (formerly, American Mobile Radio Corporation). As discussed below, Sirius and XM have since merged to form a single company – Sirius XM Radio, Inc. (Sirius XM) – but the merged entity continues to operate the Sirius and XM systems as separate networks and there is still a separate license for each system. See Applications for Consent to the Transfer of Control of Licenses XM Satellite Radio Holdings Inc., Transferor, to Sirius Satellite Radio Inc., Transferee, *Memorandum Opinion and Order and Report and Order*, MB Docket No. 07-57, 23 FCC Rcd 12348 (2008) (“*SDARS Merger Order*”). Sirius and XM were separate entities at the time they filed pleadings in this proceeding prior to the merger, but filed as the combined entity, Sirius XM, subsequent to the merger. We shall refer to them as separate entities or the combined entity, hereafter, as appropriate.

¹¹ The WCS spectrum is separated into paired blocks (A and B) that have been allocated on a regional basis, and unpaired blocks (C and D) that have been allocated over very wide service areas. For more on the WCS spectrum blocks, see *infra*, Section III.A.

A. SDARS Overview

7. The Commission's rules define SDARS – commonly known as “satellite radio” – as “[a] radiocommunication service in which audio programming is digitally transmitted by one or more space stations directly to fixed, mobile, and/or portable stations, and which may involve complementary repeating terrestrial transmitters, telemetry, tracking and control facilities.”¹² Thus, SDARS is primarily a satellite-delivered service in which programming is sent directly from satellites to subscriber receivers either at a fixed location or in motion. Because a direct line of sight is generally required in order to receive an acceptable satellite signal, ground-based terrestrial repeaters are used in many areas to re-transmit the same signals provided by satellites directly to subscribers in order to maintain adequate signal power.¹³ These areas include “urban canyons” between tall buildings, heavily foliated areas, tunnels, and other places where obstructions could limit satellite visibility or cause multipath interference from reflected signals.¹⁴

8. Licenses to provide SDARS within the United States were awarded by auction in early April, 1997.¹⁵ The two winners of the auction – XM and Sirius – were each assigned 12.5 megahertz of spectrum for their exclusive use on a primary basis.¹⁶ XM and Sirius launched their satellites and began commercial operations in 2001 and 2002, respectively.¹⁷ As of March 31, 2010, Sirius XM reported it had 18,944,199 subscribers in the conterminous United States.¹⁸

9. On August 5, 2008, the Commission approved the merger of XM and Sirius, which have subsequently combined to form a merged entity called “Sirius XM.”¹⁹ In the merger proceeding, the Commission found that significant engineering differences in the XM and Sirius infrastructures make

¹² 47 C.F.R. § 25.201.

¹³ See Amendment of Part 27 of the Commission’s Rules to Govern the Operation of Wireless Communications Services in the 2.3 GHz Band and Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band, *Notice of Proposed Rulemaking and Second Further Notice of Proposed Rulemaking*, WT Docket No. 07-293 and IB Docket No. 95-91, 22 FCC Rcd 22123, 22123 n.2 (2007) (we refer to the item containing the two notices as the “2007 Notice”).

¹⁴ *Id.*

¹⁵ See Public Notice, “FCC Announces Auction Winners for Digital Audio Radio Service,” 12 FCC Rcd 18727 (Apr. 2, 1997). Sirius and XM Radio paid a total of \$173.2 million for the 2 SDARS licenses.

¹⁶ See *American Mobile Radio Corporation Application for Authority to Construct, Launch, and Operate Two Satellites in the Satellite Digital Audio Radio Service*, Order and Authorization, 13 FCC Rcd 8829 (Int’l Bur. 1997) (“1997 XM Authorization Order”), modified by 16 FCC Rcd 18484, application for review denied, 16 FCC Rcd 21431 (2001), *aff’d sub nom. Primosphere Ltd. Partnership v. FCC* (Case Nos. 01-1526 and 1527), 2003 WL 472239 (C.A.D.C. Feb. 21, 2003); *Satellite CD Radio, Inc. Application for Authority to Construct, Launch, and Operate Two Satellites in the Satellite Digital Audio Radio Service*, Order and Authorization, 13 FCC Rcd 7971 (Int’l Bur. 1997) (“1997 Sirius Authorization Order”), application for review denied, 16 FCC Rcd 21458 (2001), *aff’d sub nom. Primosphere Ltd. Partnership v. FCC* (Case Nos. 01-1526 and 1527), 2003 WL 472239 (C.A.D.C. Feb. 21, 2003).

¹⁷ XM Radio commenced nationwide commercial service in September 2001. Sirius began commercial service in February 2002.

¹⁸ Sirius XM’s SEC Form 10-Q, filed May 7, 2010, lists 18,944,199 total subscribers; 9,157,165 subscribers on the SIRIUS system and 9,787,034 subscribers on the XM system, as of March 31, 2010. See Sirius XM’s SEC Form 10-Q, available at http://www.faqs.org/sec-filings/100507/SIRIUS-XM-RADIO-INC_10-Q/. The conterminous United States consists of the contiguous 48 States and the District of Columbia. 47 C.F.R. § 2.1.

¹⁹ *SDARS Merger Order*, 23 FCC Rcd at 12351-52 ¶ 1. See also *Sirius XM July 29, 2008, Press Release*.

integration of the two systems difficult in the short term.²⁰ In addition, the Commission noted that XM and Sirius had each invested significantly in their existing infrastructure, with the expectation of operating this infrastructure for years to come.²¹ Thus, despite the merger of the two companies, the XM and Sirius satellite and repeater infrastructures will operate as separate, legacy systems, at least in the near term.²²

10. Sirius XM offers hundreds of channels of music, entertainment, news, and sports programming on the Sirius and XM satellite radio networks, as well as weather and data information services for maritime, aeronautical, and other purposes.²³ SDARS radio receivers are used in cars, trucks, boats, aircraft, and homes – and are available for portable use.²⁴ All of Sirius XM’s arguments about interference have focused on protecting SDARS receivers located in close proximity to mobile WCS transmitters, particularly in automobiles.²⁵ Thus, we analyze this worst-case interference scenario and make our determinations accordingly. Nevertheless, the 2.5-megahertz WCS guard bands and the limits on WCS customer premises equipment and mobile and portable devices’ power, OOB, and duty cycle that we are adopting, along with the signal attenuation that is attendant with the propagation of a WCS signal through the walls of a structure, will be sufficient to prevent harmful interference to in-home SDARS receivers.

B. WCS Overview

11. The Commission’s rules define WCS as a radiocommunication service licensed pursuant to Part 27 of the Commission’s rules in specified frequency bands, including the 2305-2320 and 2345-2360 MHz bands.²⁶ The Commission established the WCS in February 1997.²⁷ Licensees in this service are permitted to provide fixed, mobile, portable, and radiolocation services.²⁸ The Commission found that allowing a broad range of services would permit the development and deployment of new telecommunications services and products to consumers.²⁹ Specific potential services advocated by WCS proponents in 1997 included high-speed wireless Internet access, return links for interactive cable and broadcasting services, mobile data, fixed terrestrial use, and the provision of wireless local loop services.³⁰ The Commission auctioned 128 WCS licenses in April 1997.³¹ In July 1997, the Commission issued licenses to the WCS auction winners.³²

²⁰ *SDARS Merger Order*, 23 FCC Rcd at 12360-61 ¶ 24.

²¹ *SDARS Merger Order*, 23 FCC Rcd at 12361 ¶ 24.

²² *SDARS Merger Order*, 23 FCC Rcd at 12360-61 ¶ 23.

²³ *See SDARS Merger Order*, 23 FCC Rcd at 12351-52 ¶ 2. In addition, Sirius offers streaming video services in select vehicles. *Id.*

²⁴ *SDARS Merger Order*, 23 FCC Rcd at 12351-52 ¶ 2.

²⁵ *See Sirius XM Ex Parte* dated Fed. 9, 2009; *Sirius XM Ex Parte* dated Aug. 11, 2009.

²⁶ 47 C.F.R. §§ 27.4, 27.5.

²⁷ *See Amendment of the Commission’s Rules to Establish Part 27, the Wireless Communications Service*, GN Docket No. 96-228, *Report and Order*, 12 FCC Rcd 10785 (1997) (*WCS Report and Order*).

²⁸ *See id.* at 10797 ¶ 25. The Commission also permitted WCS licensees to provide SDARS in the 2310-2320 and 2345-2360 MHz bands that were previously allocated to SDARS. *See id.*

²⁹ *See id.* at 10798 ¶ 26.

³⁰ *See id.* at ¶ 27.

³¹ *See* “WCS Auction Closes, Winning Bidders in the Auction of 128 Wireless communications Service Licenses,” *Public Notice*, DA 97-886, 12 FCC Rcd 21653 (rel. Apr. 28, 1997).. Seventeen winning bidders won 126 WCS

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12. *WCS Blocks A and B.* In 1997, the Commission awarded WCS licenses for 2 paired 5-megahertz-wide channel blocks (WCS Blocks A and B) in 52 Major Economic Areas (MEAs) authorizing service on 10 megahertz of spectrum.³³ WCS Block A is comprised of spectrum at 2305-2310 MHz paired with 2350-2355 MHz. The lower band edge of Block A (2305 MHz) is adjacent to a 5-megahertz-wide Amateur Radio Service band at 2300-2305 MHz,³⁴ and second adjacent to Federal Deep Space Network (DSN) Receivers at 2290-2300 MHz. WCS Block B is immediately above Block A, and is comprised of spectrum at 2310-2315 MHz paired with 2355-2360 MHz. The upper band edge of Block B (2360 MHz) is adjacent to an Aeronautical Mobile Telemetry (AMT) Service band at 2360-2395 MHz.

13. *WCS Blocks C and D.* The Commission also awarded WCS licenses for 2 unpaired 5-megahertz-wide channel blocks (WCS Blocks C and D) in 12 Regional Economic Area Groupings (REAGs) separately authorizing service on 5 megahertz of spectrum.³⁵ WCS Block C is located at 2315-2320 MHz and is adjacent to the lower band edge of the SDARS spectrum at 2320-2345 MHz. WCS Block D is located at 2345-2350 MHz and is adjacent to the upper band edge of the SDARS spectrum.

14. Although the Commission permitted WCS licensees to provide both fixed and mobile services, it adopted different power and OOB limits for these two classes of service.³⁶ For WCS fixed operations in the 2305-2320 and 2345-2360 MHz bands, the Commission adopted a power limit of 2 kW peak EIRP.³⁷ The Commission also required WCS fixed stations' OOB to be attenuated below the transmitter power (P) within the SDARS frequencies of 2320-2345 MHz by a factor not less than $80 + 10 \log (P)$ dB.³⁸ For WCS mobile stations, the Commission adopted a peak power limit of 20-W EIRP³⁹ and required an OOB attenuation factor of not less than $110 + 10 \log (P)$ dB within the SDARS frequencies.⁴⁰ The Commission adopted these power and OOB limits, in part, to protect neighboring SDARS operations from harmful interference.⁴¹

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licenses with total net bids of more than \$13.6 million. Two licenses did not receive bids after a standing high bid was withdrawn.

³² See Public Notice, "FCC Announces the Grant of Wireless Communications Service ("WCS") Licenses, Balance of Winning Bids are Due by August 4, 1997," 13 FCC Rcd 4782 (rel. Jul. 21, 1997).

³³ See Public Notice, April 28, 1997, 12 FCC Rcd 21653. An MEA map is available at <http://wireless.fcc.gov/auctions/data/maps/mea.pdf>.

³⁴ 47 C.F.R. § 97.303(j)(2)(i).

³⁵ A REAG map is available at <http://wireless.fcc.gov/auctions/data/maps/REAG.pdf>.

³⁶ An out-of-band emission is an "[e]mission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excludes spurious emissions." 47 C.F.R. § 2.1.

³⁷ 47 C.F.R. § 27.50(a)(1).

³⁸ 47 C.F.R. § 27.53(a)(1).

³⁹ 47 C.F.R. § 27.50(a)(2).

⁴⁰ 47 C.F.R. § 27.53(a)(2). The rules for WCS portable devices operating in the 2305-2315 MHz band were slightly relaxed, however. Specifically, in the 2305-2315 MHz band, WCS portable devices' peak transmitter output power was limited to 200 milliwatts (mW) (25 mW average power), and their OOB in the 2320-2345 MHz band must have been attenuated by a factor of not less than $93 + 10 \log (P)$ dB. 47 C.F.R. § 27.53(a)(9) and (a)(9)(iii).

⁴¹ Amendment of the Commission's Rules to Establish Part 27, the Wireless Communications Service, Memorandum Opinion and Order, GN Docket No. 96-228, 12 FCC Rcd 3977, 3991 ¶ 25 (1997) ("*WCS Reconsideration Order*").

15. Originally, the Commission's rules required WCS licensees to make a showing of substantial service in their license areas by the end of their initial 10-year license term, which commenced on July 21, 1997.⁴² However, in December 2006, the Wireless Telecommunications Bureau (WTB) granted a 3-year extension of the construction deadline for certain WCS licensees.⁴³ WCS licensees argued, among other things, that the uncertainty regarding the rules governing the operation of adjacent-band SDARS terrestrial repeaters had hindered WCS equipment development, network design, and facility deployment, and that an extension would allow them to deploy newly developed WiMAX⁴⁴ technology in the 2.3 GHz band in the next few years.⁴⁵ WTB found that the possibility of WiMAX deployment warranted a 3-year extension of the initial 10-year construction requirement.⁴⁶ Thus, the current deadline for meeting the construction requirements set forth in Section 27.14 of the Commission's rules was extended until July 2010 for WCS licensees.

C. Procedural History

1. 1997 Further Notice

16. Although the Commission adopted service rules for most aspects of SDARS operations in 1997,⁴⁷ it did not adopt rules governing terrestrial repeater operations at that time. Instead, the Commission concurrently issued a Further Notice of Proposed Rulemaking (*1997 Further Notice*) seeking comment on the proposed use and authorization of SDARS terrestrial repeaters.⁴⁸ The *1997 Further Notice* acknowledged the SDARS applicants' intention to use repeaters in conjunction with their satellite systems and proposed authorizing deployment of SDARS repeaters on an "as-needed" basis in order to meet service requirements.⁴⁹ The *1997 Further Notice* also invited comment to address any potential impact that the operation of SDARS repeaters would have on the services of neighboring countries and on any potential effects RF emissions from SDARS repeaters may have on the public.⁵⁰ In addition, the *1997 Further Notice* sought comment on how the Commission's Rules could ensure that any use of SDARS repeaters remains complementary to the satellite service, as well as on the tentative conclusion to prohibit the use of SDARS repeaters to transmit locally originated programming.⁵¹

⁴² 47 C.F.R. § 27.14(a).

⁴³ Consolidated Request of the WCS Coalition for Limited Waiver of Construction Deadline for 132 WCS Licenses, *Order*, 21 FCC Rcd 14134 (2006) ("*WCS Extension Order*").

⁴⁴ WiMAX (Worldwide Interoperability for Microwave Access) is a wireless broadband access technology based on the Institute of Electrical and Electronics Engineers (IEEE) 802.16 standard which supports delivery of non-line-of-sight connectivity between a subscriber station and base station with a typical cell radius of 3 to 10 kilometers. WiMAX can support fixed and nomadic, as well as portable and mobile wireless broadband applications. The latest version of the standard on which WiMAX is based, IEEE 802.16(e), has specifications for the 2 to 11 GHz range, uses scalable orthogonal frequency division multiple access (OFDMA), and supports both FDD and TDD profiles. See generally <http://www.wimaxforum.org/resources/frequently-asked-questions>.

⁴⁵ *WCS Extension Order*, 21 FCC Rcd at 14137 ¶ 5.

⁴⁶ *WCS Extension Order*, 21 FCC Rcd at 14140-41 ¶ 12.

⁴⁷ Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band, *Report and Order, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking*, 12 FCC Rcd 5754 (1997) ("*SDARS Order and FNPRM*" or "*1997 Further Notice*").

⁴⁸ See *SDARS Order and FNPRM*, 12 FCC Rcd at 5810-12 ¶¶ 138-142.

⁴⁹ See *id.* at 5812 ¶ 142.

⁵⁰ See *id.*

⁵¹ See *id.*

17. In response to the *1997 Further Notice* and later supplemental filings by Sirius and XM,⁵² the WCS licensees expressed concern about the possibility of harmful blanketing interference to WCS base stations and customer premises equipment (CPE) from SDARS repeaters operating at more than 2 kW EIRP.⁵³ In addition to WCS licensees, Broadband Radio Service (BRS) and Educational Broadband Service (EBS) (formerly Multipoint Distribution Service (MDS) and Instructional Television Fixed Service (ITFS), respectively) licensees operating in the 2150-2162 and 2496-2690 MHz frequency bands raised similar concerns.⁵⁴ Specifically, WCS, BRS, and EBS licensees raised concerns over two types of potential interference from SDARS repeater operations: “blanketing interference” and “third order intermodulation distortion (IMD).”⁵⁵ More recently, the WCS licensees have raised concerns regarding overload and adjacent band OOB interference to WCS base stations from SDARS terrestrial repeaters.⁵⁶

18. SDARS licensees generally acknowledged the possibility of blanketing interference and IMD, but opposed placing a 2 kW EIRP limit on their repeater operations. SDARS licensees argued that such a limit would impose substantial costs on SDARS licensees and that WCS and other terrestrial wireless licensees could mitigate any potential interference from SDARS repeater operations, respectively, by converting wireless operations from analog to digital, and by using WCS down-converters that are sufficient to protect against interference from the proposed SDARS repeaters.⁵⁷

⁵² See Letter from Robert D. Briskman, Chief Technical Officer, CD Radio Inc., to Rosalee Chiara, Deputy Chief, Satellite Policy Branch, International Bureau, FCC, dated Nov. 14, 1997; Letter from William Garner, Chief Scientist, American Mobile Radio Corporation, to Rosalee Chiara, Deputy Chief, Satellite Policy Branch, International Bureau, FCC, dated Nov. 14, 1997; Supplemental Comments of Sirius Satellite Radio (filed Jan. 18, 2000) (Sirius Supplemental Comments); Supplemental Comments of XM Radio Inc. (filed Dec. 17, 1999) (XM Radio Supplemental Comments).

⁵³ See WCS Coalition Comments (dated Dec. 14, 2001) at 3-4. Blanketing interference occurs when a receiver is near a relatively high-powered adjacent-band transmitter and the high power overloads the components of the receiver and prevents reception of the desired signal by the receiver. See Sirius Satellite Radio, Inc., Application for Special Temporary Authority to Operate Satellite Digital Audio Radio Service Complementary Terrestrial Repeaters, *Order and Authorization*, 16 FCC Rcd 16773, 16774 n.5 (Int’l Bur. 2001) (“*Sirius 2001 STA Order*”); XM Radio, Inc., Application for Special Temporary Authority to Operate Satellite Digital Audio Radio Service Complementary Terrestrial Repeaters, *Order and Authorization*, 16 FCC Rcd 16781, 16782 n.5 (Int’l Bur. 2001) (“*XM Radio 2001 STA Order*”).

⁵⁴ See Wireless Communications Association International, Inc. (WCA) Comments (filed Feb. 22, 2000) at 2; BellSouth Corporation and BellSouth Wireless Cable, Inc. Comments (filed Feb. 22, 2000) at 6-7. See also Metricom, Inc. Reply Comments (filed March 8, 2000) at 2-3; MCI WorldCom, Inc. Reply Comments (filed March 8, 2000) at 2-3, and WCS Coalition Comments at 2-3 (filed Dec. 14, 2001) at 3-4.

⁵⁵ The SDARS licensees operate their terrestrial repeaters in the middle of their authorized frequency bands (*i.e.*, 2324.54-2327.96 MHz for Sirius and 2336.225-2341.285 for XM). WCS licensees fear that the SDARS repeater frequencies will cause IMD interference when they mix with WCS transmission frequencies to form higher frequencies that will land directly in the WCS band and render WCS receivers inoperable. See WCS Coalition Comments (filed Dec. 14, 2001) at 3-4.

⁵⁶ See, *e.g.*, WCS Coalition Reply Comments, WT Docket No. 07-293, filed March 17, 2008, at 18-26, and WCS Coalition Comments, WT Docket No. 07-293, filed February 14, 2008, at 21-22. Overload interference, like blanketing interference, occurs when a receiver is near a relatively high-powered adjacent band transmitter and the high power from the transmitter overloads the components of the receiver and prevents reception of the desired signal. See n.53, *supra*. Out-of-band emissions (OOBE) from an adjacent-channel licensee’s transmitter are received in-band to the desired signal’s receiver and if over a prescribed limit, can interfere with and prevent the reception of the desired transmitter’s signal.

⁵⁷ See Reply Comments of Sirius Satellite Radio (filed Mar. 8, 2000) at 2-3; Consolidated Reply of XM Radio Inc. (filed Mar. 8, 2000) at 8.

We note that since the inception of this proceeding, BRS and EBS licensees operating in the 2150-2162 and 2496-2690 MHz bands have converted from analog to digital technology. With this transition, coupled with the large frequency separation between the SDARS operations and the BRS/EBS operations, there have not been any complaints of interference to BRS or EBS operations from SDARS terrestrial repeaters' transmissions even though a substantial number of SDARS repeaters have been operating with an EIRP greater than 2 kW.

19. Commission staff met with SDARS and WCS licensees several times in 2001 to supplement the record on these issues.⁵⁸ In November 2001, the International Bureau sought comment on various additional proposals to resolve interference (“2001 Public Notice”),⁵⁹ but the supplemental record developed in response to that Public Notice did not provide a basis for resolving these issues.⁶⁰ Because of the inability to reach a consensus on final rules, SDARS licensees have been operating terrestrial repeaters pursuant to grants of special temporary authority (STA), which were granted on a non-interference basis and subject to other conditions.⁶¹

2. 2007 Notice

20. In May 2002, at the request of SDARS and WCS licensees, the Commission decided to refrain from adopting SDARS repeater rules and to allow SDARS and WCS licensees to attempt to resolve the interference concerns privately.⁶² Although initially promising, the negotiations were ultimately unsuccessful.⁶³ After nearly 4 years of private negotiations, Sirius filed a White Paper in which it examined the technical difficulties involved in SDARS and WCS co-existence in the S-band.⁶⁴ In October 2006, Sirius filed a petition for rulemaking which included new proposals for resolving interference issues between SDARS and WCS licensees.⁶⁵ Sirius' proposals were based chiefly on its previously-filed White Paper. XM supported Sirius' proposals and urged the Commission to seek

⁵⁸ For example, the International, Wireless Telecommunications, and Media Bureaus of the Commission – together with the Commission's Office of Engineering and Technology – held industry meetings on January 11, 2001, March 1, 2001, and August 30, 2001, with the SDARS licensees' and WCS licensees' representatives in an attempt to craft solutions to the SDARS-WCS interference issues. See Letter from Paul J. Sinderbrand, Counsel for WCIA, to Secretary, FCC, dated Jan. 11, 2001; Letter from Carl R. Frank, Counsel for Sirius, to Secretary, FCC, dated Mar. 2, 2001; Letter from Donald C. Brittingham, Director of Spectrum Policy, Verizon, to Secretary, FCC, dated Aug. 31, 2001.

⁵⁹ Request for Further Comment on Selected Issues Regarding the Authorization of Satellite Digital Audio Radio Service Terrestrial Repeater Networks, *Public Notice*, Report No. SPB-176, 16 FCC Rcd 19435 (Int'l Bur., 2001) (2001 Public Notice).

⁶⁰ 2007 Notice, 22 FCC Rcd at 22127 ¶ 10.

⁶¹ See generally *Sirius 2001 STA Order* and *XM 2001 STA Order*. Since 2001, both Sirius and XM have submitted additional STA requests seeking to modify their repeater networks or to add new repeaters. A full list of SDARS STA requests are available through the International Bureau Filing System (IBFS), which is available online at <http://licensing.fcc.gov/myibfs>.

⁶² 2007 Notice, 22 FCC Rcd at 22127 ¶ 10.

⁶³ 2007 Notice, 22 FCC Rcd at 22127 ¶ 10.

⁶⁴ 2007 Notice, 22 FCC Rcd at 22128 ¶ 12, citing White Paper: Interference to the SDARS Service from WCS Transmitters, attached to Letter from Carl R. Frank, Counsel to Sirius Satellite Radio Inc., to Marlene H. Dortch, Secretary, FCC, WT Docket No. 05-256 and IB Docket No. 95-91 (Mar. 29, 2006) (“Sirius 2006 White Paper”).

⁶⁵ 2007 Notice, 22 FCC Rcd at 22128 ¶ 12, citing Sirius Satellite Radio Inc., Petition for Rulemaking and Comments (filed Oct. 17, 2006) (“2006 Sirius Petition for Rulemaking”).

comment on them expeditiously.⁶⁶ In response to Sirius' petition, WCS licensees offered their own counter-proposals for the resolution of SDARS and WCS interference issues.⁶⁷

21. The Commission determined that Sirius' proposal and WCS licensees' counterproposal could provide a basis for resolving the ongoing issues of potential interference between SDARS terrestrial repeaters and WCS stations.⁶⁸ The Commission also decided to take the opportunity to update and refresh the record on other issues raised in the *1997 Further Notice* and the *2001 Public Notice*.⁶⁹ Accordingly, in December 2007, the Commission issued a Second Further Notice of Proposed Rulemaking in IB Docket No. 95-91, inviting comment on issues related to the operation of SDARS terrestrial repeaters. In order to have the greatest flexibility in resolving interference issues between SDARS and WCS licensees and develop a record that would enable the provision of innovative broadband services in the 2.3 GHz WCS band, the Commission also issued a Notice of Proposed Rulemaking in a new docket (WT Docket No. 07-293), which sought comment on proposals to make changes to the Commission's rules in Part 27 governing WCS operations.⁷⁰ In response to the Commission's notice, eight comments were filed on February 14, 2008, and five reply comments were filed on March 17, 2008.⁷¹ Since the closing of the comment periods, numerous *ex parte* presentations have been made in these proceedings.⁷²

22. In a related matter, the current performance requirements (also known as "buildout" or "construction" requirements) for all spectrum blocks in the 2.3 GHz WCS band is a substantial showing at the end of the license term.⁷³ On March 29, 2010, the Commission sought comment on whether, if we alter the technical rules for this band, we should also revise the substantial service performance requirements (*WCS Performance Public Notice*).⁷⁴ Specifically, the Commission sought comment on particular reliable signal and license area coverage benchmarks for WCS mobile and point-to-multipoint services and possible alternatives, on particular link construction and operation benchmarks for WCS

⁶⁶ See *2007 Notice*, 22 FCC Rcd at 22128 ¶ 12.

⁶⁷ *2007 Notice*, 22 FCC Rcd at 22128 ¶ 12, citing Letter from Paul J. Sinderbrand, Counsel to the WCS Coalition, to Marlene H. Dortch, Secretary, FCC, dated July 9, 2007 ("*WCS July 2007 Letter*").

⁶⁸ *2007 Notice*, 22 FCC Rcd at 22124 ¶ 2 and 22128-29 ¶ 14.

⁶⁹ *2007 Notice*, 22 FCC Rcd at 22128-29 ¶ 14.

⁷⁰ *2007 Notice*, 22 FCC Rcd at 22124 ¶ 3.

⁷¹ A list of these commenters and reply commenters is shown in Appendix A to this Order. Pleadings filed in response to the *1997 Further Notice* and the *2001 Public Notice* are listed in Appendix A to this Order. In addition, a number of parties in the SDARS Merger proceeding, MB Docket No. 07-57, filed arguments related to that proceeding in these proceedings. In some cases, repeater issues were relevant to the proposed merger of Sirius and XM. The Commission addressed those issues in the context of the merger, and we referenced those conclusions in this proceeding. Other repeater issues that were raised in the context of the merger, however, were not relevant to the merger. To the extent that those arguments were not also raised in these proceedings, they were filed in a procedurally deficient manner, and therefore will not be considered further.

⁷² A list of significant *ex parte* presentations relied on in this Order is included in Appendix A.

⁷³ Section 27.14(a) of the Commission's rules provides that 2.3 GHz WCS licensees "must, as a performance requirement, make a showing of 'substantial service' in their license area within the prescribed license term set forth in § 27.13." 47 C.F.R. § 27.14(a). The rule defines substantial service "as service which is sound, favorable and substantially above a level of mediocre service which just might minimally warrant renewal." *Id.* Section 27.14(a) provides that failure by any WCS licensee to meet its performance "requirement will result in forfeiture of the license and the licensee will be ineligible to regain it." *Id.*

⁷⁴ See Federal Communications Commission Requests Comment on Revision of Performance Requirements for 2.3 GHz Wireless Communications Service, WT Docket No. 07-293, Public Notice, FCC 10-46, 75 Fed. Reg. 17349 (rel. Mar. 29, 2010).

point-to-point services and possible alternatives, and on related construction notification filing requirements.⁷⁵ In response to the Commission's *WCS Performance Public Notice*, six comments were filed by April 21, 2010; seven reply comments were filed by May 3, 2010.⁷⁶

23. On April 2, 2010, Commission staff issued a public notice seeking comment on draft interference rules for the WCS and SDARS (*WCS/SDARS Technical Rules Public Notice*).⁷⁷ Specifically, Commission staff sought comment on provisions intended to minimize the risk of harmful interference from WCS mobile and portable devices to SDARS, AMT, and DSN receivers. In addition, Commission staff sought comment on draft technical rules for SDARS terrestrial repeaters intended to minimize the potential for harmful interference to WCS receivers. Commission staff also sought comment on licensing provisions for SDARS terrestrial repeaters, as well as rules regarding the use of terrestrial repeaters to originate local programming.⁷⁸ In response to the Commission staff's *WCS/SDARS Technical Rules Public Notice*, 14 comments were filed by April 23, 2010.⁷⁹

24. In the mid-1990's when the Commission allocated spectrum and adopted service rules for WCS and SDARS, only general information was available on what new wireless applications might be deployed in the WCS spectrum and minimal information was provided on how the SDARS licensees intended to deploy terrestrial repeaters or gap-fillers. The wireless sector, however, has seen dramatic growth in the past decade. Wireless subscribers grew from approximately 24 million subscribers in 1994 to more than 263 million by the end of 2007.⁸⁰ The National Broadband Plan recognized that the convergence of Internet computing and mobile communications is rapidly fueling the demand for mobile broadband services.⁸¹ The 2.3 GHz WCS spectrum will help to increase the supply of flexible use spectrum that can be used to address the explosive nationwide growth in consumer demand for mobile broadband services.

25. The SDARS licensees have seen dramatic increases in subscribers since they initiated service only a few short years ago. As of the end of 2009, there were over 18 million consumers subscribing to SDARS throughout the conterminous United States, with the large majority of them using the service while in their automobiles.⁸² To help improve the quality of the consumers' audio experience, the SDARS licensees have deployed significant numbers of repeaters mainly in large market areas⁸³ where satellite coverage could be blocked or attenuated.

⁷⁵ *Id.* at 2-3.

⁷⁶ A list of these commenters is shown in Appendix A to this Order.

⁷⁷ See Commission Staff Requests That Interested Parties Supplement the Record On Draft Interference Rules for Wireless Communications Service and Satellite Digital Audio Radio Service, WT Docket No. 07-293, IB Docket No. 95-91, GEN Docket No. 90-357, RM No. 8610, Public Notice, DA 10-592 (rel. Apr. 2, 2010).

⁷⁸ *Id.*

⁷⁹ A list of these commenters is shown in Appendix A to this Order.

⁸⁰ See Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, WT Docket No. 08-27; Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services, *Thirteenth Report*, 24 FCC Rcd 6185, 6280-81 ¶ 197 (WTB 2009).

⁸¹ See Connecting America: The National Broadband Plan at 75.

⁸² See Annual Report Pursuant to Section 13 of 15(d) of the Securities Exchange Act of 1934 for Fiscal Year Ended December 31, 2009, Sirius XM Radio Inc. (filed February 25, 2010), at 2, *available at* <http://files.shareholder.com/downloads/SIRI/902162459x0xS950123-10-17181/908937/filing.pdf>.

⁸³ Today, the top 15 markets covered by repeaters include Atlanta, Boston, Chicago, Dallas, Detroit, Las Vegas, Los Angeles, Miami, Minneapolis, New York, Philadelphia, Pittsburgh, San Francisco, Seattle, and Washington, DC.

26. Because both services target the same types of consumers (*i.e.*, those who are mobile, particularly in vehicles for long periods of time), the anticipated growth of these services presents the potential for mutual interference under certain scenarios. For example, a mobile WCS transmitter may cause interference to a mobile SDARS receiver when the SDARS receiver is in close proximity to the WCS transmitter. Alternatively, when the SDARS terrestrial repeaters and WCS base stations are serving the same geographic areas (*i.e.*, in dense urban areas and along major corridors leading to and from those areas), the relatively higher power repeaters have a potential to interfere with WCS mobile station and base station receivers. Our objective in this proceeding is to foster the co-existence of these services despite the technical difficulties that arise from them being in close proximity to each other, both geographically and in the radio frequency spectrum.

27. Over the past several years, we have provided numerous opportunities for the parties to come to an agreement that would facilitate Commission adoption of rules for both services and provide for their deployment and growth without many of the uncertainties that still exist today. Our efforts to persuade the parties to come to agreement have been unsuccessful, however, and the time to bring closure to this long-standing rulemaking has arrived. Our approach to move forward is described in detail in the following sections.

III. REPORT AND ORDER IN WT DOCKET NO. 07-293

A. Introduction

28. Our objective in this Report and Order is to craft WCS service rules that will allow the WCS to co-exist with adjacent band SDARS without reaching the threshold of SDARS experiencing harmful interference.⁸⁴ The service rules we adopt today will not result in an environment where interference will never occur under any circumstances. However, based on the technical record of this proceeding, the results of several tests conducted by Sirius XM and the WCS Coalition,⁸⁵ and FCC staff observations of tests Sirius XM and the WCS Coalition each conducted in Ashburn, VA, we are confident that the instances where WCS would seriously degrade or obstruct or repeatedly interrupt SDARS reception will be rare. Furthermore, consistent with the Commission's long-standing policies of maintaining technical and service neutrality in its rules and allowing flexible spectrum use by licensees, we adopt rules that remain technology neutral instead of adopting rules that mandate the use of a particular technology or service. Our requirements for the WCS power limits and OOB attenuation are based on a balancing of the need to provide for multiple types of mobile broadband platforms and the need to protect SDARS mobile receivers from harmful interference.

29. As explained below, we find that the public interest will be served by revising certain WCS power and OOB rules to enable the deployment of mobile broadband services in the WCS bands. Balancing the competing interests of SDARS and WCS providers, considering commenters' technical proposals, and basing our decisions on the extensive technical record, as well as on the results of the testing Sirius XM and the WCS Coalition each performed in Ashburn, Virginia,⁸⁶ we are adopting rules, as explained below, that are crafted to limit the potential for harmful interference to satellite radio users in

⁸⁴ Harmful interference is defined as: "Interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with [the ITU] Radio Regulations. 47 C.F.R. § 2.1.

⁸⁵ The WCS Coalition was founded by the Wireless Communications Association International, Inc. ("WCA") and includes Horizon Wi-Com LLC ("Horizon"), AT&T Inc., Comcast Corporation, NTELOS Inc. and NextWave Broadband Inc., who collectively hold virtually all the 2305-2320/2345-2360 MHz WCS spectrum within the United States. See WCS Coalition Comments (dated Feb. 14, 2008) at 1, n.1.

⁸⁶ See paras. 55-58 and 93-96, *infra*.

the SDARS band and foster the provision of mobile services by WCS providers. Specifically, we decrease the power limit for mobile device operations in WCS spectrum Blocks A and B, and the 2.5-megahertz portions of WCS Blocks C and D that are furthest removed from the SDARS band (*i.e.*, 2305-2317.5 and 2347.5-2360 MHz) from the current 20-W EIRP limit to a 250-mW average EIRP per 5 megahertz limit. Mobile and portable devices using TDD are limited to an uplink duty cycle of 38 percent. Mobile and portable devices using FDD technology are limited to an uplink duty cycle of 25 percent and are restricted to transmitting in the 2305-2317.5 MHz band.⁸⁷ WCS mobile and portable devices are not permitted to operate in the 2.5-megahertz portions of WCS Blocks C and D closest to the SDARS band (*i.e.*, 2317.5-2320 and 2345-2347.5 MHz). WCS mobile and portable devices must also use ATPC when operating, so the device operates with the minimum power necessary for successful communications.⁸⁸

30. For mobile and portable WCS devices operating in the WCS A and B blocks and the 2.5-megahertz portions of the WCS C and D blocks furthest removed from the SDARS band, we also relax the OOB attenuation factors of $110 + 10 \log(P)$ dB and $93 + 10 \log(P)$ dB, respectively, that currently apply to these devices' emissions into the 2320-2345 MHz SDARS band. Specifically, as measured over a 1-megahertz resolution bandwidth, these WCS mobile and portable devices' OOB must be attenuated below the transmitter power P by a factor of not less than $43 + 10 \log(P)$ dB on all frequencies between 2305-2317.5 MHz and between 2347.5-2360 MHz that are outside the licensed band of operation, not less than $55 + 10 \log(P)$ dB in the 2320-2324/2341-2345 MHz bands, not less than $61 + 10 \log(P)$ dB in the 2324-2328/2337-2341 MHz bands, and not less than $67 + 10 \log(P)$ dB in the 2328-2337 MHz band, where P is the transmitter output power in Watts.⁸⁹ In addition, the OOB from WCS mobile and portable devices must be attenuated by a factor of not less than $43 + 10 \log(P)$ dB in the 2300-2305 and 2360-2365 MHz bands, not less than $55 + 10 \log(P)$ dB in the 2296-2300 MHz band, not less than $61 + 10 \log(P)$ dB in the 2292-2296 MHz band, not less than $67 + 10 \log(P)$ dB in the 2288-2292 MHz band, and not less than $70 + 10 \log(P)$ dB below 2288 MHz and above 2365 MHz.

31. Furthermore, we relax the OOB attenuation required for WCS customer premises equipment (CPE) stations. Specifically, for fixed CPE transmitting with more than 2-W average EIRP, the power of any emissions must be attenuated by a factor of not less than $43 + 10 \log(P)$ dB on all frequencies between 2305-2320 MHz and on all frequencies between 2345-2360 MHz that are outside the licensed band of operation, not less than $75 + 10 \log(P)$ dB on all frequencies in the 2320-2345 MHz band, not less than $43 + 10 \log(P)$ dB in the 2300-2305 and 2360-2362.5 MHz bands, not less than $55 + 10 \log(P)$ dB in the 2362.5-2365 MHz band, not less than $70 + 10 \log(P)$ dB in the 2287.5-2300 MHz and 2365-2367.5 MHz bands, not less than $72 + 10 \log(P)$ dB in the 2285-2287.5 and 2367.5-2370 MHz bands, and not less than $75 + 10 \log(P)$ dB below 2285 MHz and above 2370 MHz.

32. For fixed CPE transmitting with 2 watts average EIRP or less, the power of any emissions must be attenuated by a factor of not less than $43 + 10 \log(P)$ dB on all frequencies between 2305-2320 MHz and between 2345-2360 MHz that are outside the licensed band of operation, not less than $55 + 10 \log(P)$ dB in the 2320-2324/2341-2345 MHz bands, not less than $61 + 10 \log(P)$ dB in the 2324-2328/2337-2341 MHz bands, and not less than $67 + 10 \log(P)$ dB in the 2328-2337 MHz band. In addition, OOB must be attenuated by a factor of not less than $43 + 10 \log(P)$ dB in the 2300-2305 and 2360-2365 MHz bands, not less than $55 + 10 \log(P)$ dB in the 2296-2300 MHz band, not less than

⁸⁷ Average power is determined only when a device is transmitting and does not include periods of time when the device is turned off.

⁸⁸ See n.5, *supra*.

⁸⁹ Under current Section 27.53(a)(9), portable devices in the 2305-2315 MHz band may operate subject to an OOB attenuation factor of $93 + 10 \log(P)$ dB into the SDARS band, provided that they meet certain technical requirements. 47 C.F.R. § 27.53(a)(9).

61 + 10 log (P) dB in the 2292-2296 MHz band, not less than 67 + 10 log (P) dB in the 2288-2292 MHz band, and not less than 70 + 10 log (P) dB below 2288 MHz and above 2365 MHz.

33. For WCS base stations supporting WCS mobile, portable, and CPE devices, we adopt an OOB attenuation factor below the transmitter power P of not less than 43 + 10 log (P) dB on all frequencies between 2305-2320 MHz and on all frequencies between 2345-2360 MHz that are outside the licensed band of operation, not less than 75 + 10 log (P) dB on all frequencies in the 2320-2345 MHz band, not less than 43 + 10 log (P) dB in the 2300-2305 and 2360-2362.5 MHz bands, not less than 55 + 10 log (P) dB in the 2362.5-2365 MHz band, not less than 70 + 10 log (P) dB in the 2287.5-2300 MHz and 2365-2367.5 MHz bands, not less than 72 + 10 log (P) dB in the 2285-2287.5 and 2367.5-2370 MHz bands, and not less than 75 + 10 log (P) dB below 2285 MHz and above 2370 MHz. All of these emission limits will be measured over a 1-megahertz resolution bandwidth.

34. Moreover, we relax the current 2-kW power limit for base and fixed station operations in WCS Blocks A and B⁹⁰ by measuring the power on an average, rather than peak, basis and adopt a peak-to-average power ratio (PAPR) of 13 dB to better enable the use of technologies such as Code Division Multiple Access (CDMA), Wideband CDMA (WCDMA), and Orthogonal Frequency Division Multiplexing (OFDM).⁹¹ We also recognize that the OFDM-based technologies currently contemplated for various fourth generation (4G) air interface technologies that could be deployed in this band are being improved in order to reduce peak power and thus, by extension, the PAPR on the uplink, which is a source of SDARS licensees' concerns regarding interference from WCS operations. Further, to minimize the potential impact on satellite radio users, we are retaining the more stringent 2 kW peak EIRP limit for base and fixed station operations in WCS Blocks C and D, which are immediately adjacent to satellite radio downlinks in the SDARS band.

35. As discussed in more detail below, we are also requiring that WCS entities coordinate the deployment of their base stations with the National Aeronautics and Space Administration's (NASA's) Deep Space Network Facility at Goldstone, CA, which operates below 2300 MHz, and with AMT operations at various locations, which operate on frequencies above 2360 MHz.

36. In this Report and Order, we also seek to promote broadband competition and facilitate the development and provision of innovative broadband services, including mobile broadband services, to the American public in the 2305-2320 and 2345-2360 MHz bands allocated to WCS.⁹² The actions we

⁹⁰ 47 C.F.R. § 27.50(a)(1).

⁹¹ CDMA is a wideband spread-spectrum technology that, *inter alia*, employs a special coding scheme, with each signal assigned a digital code. OFDM is a digital multi-carrier modulation scheme in which each signal is split into multiple smaller sub-signals that are then transmitted simultaneously at different frequencies to the receiver. But OFDM-based technologies can exhibit infrequent undesired power spikes. The larger the power spike, the greater the magnitude of the PAPR. There are, however, a number of solutions, both theoretical and practical, that can be used to substantially mitigate the effects of the PAPR. Examples of PAPR reduction include the use of simultaneously transmitted independently modulated streams in the uplink, based on Discrete Fourier Transform Spread-OFDM (DFTS-OFDM), as well as interleaved sub-carriers schemes that are currently being implemented in long term evolution (LTE) networks. Although such schemes are not part of the IEEE's 802.16e standard, the IEEE 802.16m study group is working on a similar scheme for its uplink/reverse link.

⁹² WCS licensees may provide any service for which their frequency bands are allocated, including fixed, mobile, radiolocation, and audio broadcasting-satellite services. See 47 C.F.R. §§ 2.106, 27.2(a). WCS proposals are based in large part on the desired use of the WiMAX, which is a protocol based on the harmonized IEEE 802.16/ETSI High Performance Metropolitan Area Network (HiperMAN) standard. WiMAX is sometimes referred to as the Wireless Metropolitan Area Network (WirelessMAN) standard and is used to provide fixed and mobile broadband services over distances ranging up to 10 miles (16 km), with average cell ranges for most WiMAX networks in the 4-5 mile range (6.4-8 km), depending, *inter alia*, on the frequency. See "What is the Range of WiMAX?" at <http://www.wimax.com/education/faq/faq/31>. In fixed WiMAX networks, both the base stations and subscriber

(continued...)

take in this order are designed to further our strategic broadband goal that “[a]ll Americans should have affordable access to robust and reliable broadband products and services.”⁹³ In achieving this critical broadband goal, we must also safeguard the public’s interest in continuing to receive and enjoy diverse satellite radio services, which are provided in the interstitial 2320-2345 MHz SDARS band. The relaxed technical rules that we adopt today and other related actions are intended to limit the potential for harmful interference to satellite radio users, while enabling WCS licensees to deliver mobile broadband services to the public, including to individuals residing in rural and underserved areas of the United States.

B. Systems Descriptions

37. *Descriptions of Satellite Radio Network Designs.* Sirius XM operates two satellite radio networks, the Sirius Satellite Radio, Inc., network and the XM Radio, Inc., network. We will refer to these as the Sirius network and the XM network, respectively. The Sirius network provides service directly to subscribers via a fleet of three satellites in highly-elliptical orbits (HEOs) and a satellite in geostationary satellite orbit (GSO) at the 96° West Longitude (W.L.) orbital location.⁹⁴ Sirius has also been granted authority to launch and operate a satellite to eventually replace two of its three in-orbit non-geostationary orbit (NGSO) satellites,⁹⁵ but has filed an application to convert this NGSO replacement satellite into a GSO satellite.⁹⁶ The Sirius network serves subscribers throughout the conterminous United States and includes a network of terrestrial repeaters in urban areas to re-transmit the SDARS signal to subscribers in areas where the satellite signal is blocked or degraded. That is, the terrestrial repeaters are deployed in order to maintain adequate signal power in areas where there are tall buildings, tunnels, heavy foliage, or other obstructions.⁹⁷ The XM network provides its service directly to

(Continued from previous page)

stations are stationary during use. In mobile WiMAX networks, subscriber stations (mobile and portable devices) may move during operation. Additional information regarding WiMAX technologies and their deployment is available on the WIMAX Forum’s website. See <http://www.wimaxforum.org/home/>. See WCS Coalition Comments at 4-7, 27-28, 30-32, 34; WCS Coalition Reply Comments at 2-8. Although the WCS Coalition has indicated that WCS licensees would prefer to implement systems based on TDD technology, we are not prohibiting the implementation of WCS systems based on FDD technology. See WCS Coalition *Ex Parte* dated January 29, 2010, at 2.

⁹³ See FCC Strategic Plan for FY 2009-2014 at 6, available at <http://www.fcc.gov/omd/strategicplan/#goals>. The broadband goal also provides that our “[r]egulatory policies must promote technological neutrality, competition, investment, and innovation to ensure that broadband service providers have sufficient incentive to develop and offer such products and services.” *Id.*

⁹⁴ The Commission originally licensed Sirius to launch and operate 2 satellites in geostationary orbit at the 80° and 110° West Longitude orbital locations. *1997 Sirius Authorization Order*, 13 FCC Rcd at 7971, 7994. Sirius later requested, and was granted, authority to change its satellite configuration from two geostationary satellites to three satellites in a highly elliptical non-geostationary orbit (NGSO). *Sirius Satellite Radio Inc., Minor Modification of License to Construct, Launch and Operate a Non-Geostationary Satellite Digital Audio Radio Service System*, Order and Authorization, 16 FCC Rcd 5419 (Int’l Bur. 2001). Sirius brought its first geostationary SDARS satellite, Sirius FM-5, into operation on August 25, 2009. *Sirius Satellite Radio Inc., Application for Authority to Launch and Operate SIRIUS FM-5, a Geostationary Satellite, to Provide Satellite Digital Audio Radio Services*, IBFS File No. SAT-LOA-20060901-00096 (granted April 16, 2007).

⁹⁵ See *Satellite CD Radio, Inc., Application for Modification of Authority*, IBFS File No. SAT-MOD-20080521-00110 (granted Sept. 17, 2008).

⁹⁶ See *Satellite CD Radio, Inc., Application for Authority to Launch and Operate the FM-6 Satellite*, IBFS File No. SAT-LOA-20100409-00072 (filed April 9, 2010).

⁹⁷ See, e.g., *Sirius Satellite Radio, Inc., Application for Special Temporary Authority to Operate Satellite Digital Audio Radio Service Complementary Terrestrial Repeaters*, Order and Authorization, 16 FCC Rcd 16773 (Int’l Bur. 2001) (“*Sirius STA Order*”). See also *Sirius Satellite Radio Inc., Order*, FCC 08-176 (adopted July 25, 2008) (“*Sirius Consent Decree Order*”). Sirius states that it plans to deploy a significant number of additional terrestrial repeaters in the future. See Sirius Form 10-K at 18.

subscribers via satellites located at the nominal geostationary orbit locations of 85° W.L. and 115° W.L.⁹⁸ From these orbital locations, the XM network is able to provide service to the conterminous United States, as well as parts of Alaska.⁹⁹ The XM system also includes a network of terrestrial repeaters, greater in number than those of the Sirius system, which are used to re-transmit XM's signal in areas where the satellite signal may be degraded or obstructed by tall buildings, heavy foliage, and/or tunnels.¹⁰⁰ Sirius XM operates all terrestrial repeaters pursuant to grants of special temporary authority (STA), which authorize the operations of terrestrial repeaters while this rulemaking proceeding is pending.¹⁰¹ Prior to September 11, 2009, neither Sirius nor XM operated repeaters outside the conterminous United States.¹⁰² On September 11, 2009, however, Sirius XM was granted STA to operate 20 SDARS terrestrial repeaters in the Commonwealth of Puerto Rico for a period of 180 days.¹⁰³

38. The Sirius and XM networks each use their full 12.5 megahertz of spectrum to deliver content to their respective SDARS receivers. To overcome signal obstructions and impairments, both networks transmit multiplexed digital data streams from their satellites to the users' receivers using time, frequency, and spatial signal diversity techniques. A terrestrial repeater channel may also be present if the user receiver is in an area where repeaters are deployed. Each licensee's network transmits time-diverse satellite channels on multiple frequencies allocated within the SDARS licensee's spectrum from two spatially-separated satellites in view of the users' locations.¹⁰⁴ Signal diversity is necessary to reduce outages due to a wide range of impairment factors that include electromagnetic interference and signal obstruction by buildings, hills, and trees.¹⁰⁵ The data streams transmitted by the satellites are combined in the receivers to provide diversity gain. The satellite signals are designed such that reception may be possible even when the signals from one of a licensee's satellites are blocked. Thus, the two

⁹⁸ *1997 XM Authorization Order*, 13 FCC Rcd at 8850 ¶¶ 51-52; *2005 XM Authorization Order*, 20 FCC Rcd at 1620 ¶ 1.

⁹⁹ *See SDARS Merger Order*, 23 FCC Rcd at 12355 ¶ 12..

¹⁰⁰ *Id.* *See also XM Radio Inc., Application for Special Temporary Authority to Operate Satellite Digital Audio Radio Service Complementary Terrestrial Repeaters*, Order and Authorization, 16 FCC Rcd 16781 (Int'l Bur. 2001) ("*XM Radio STA Order*"); *XM Radio, Inc.*, Order, FCC 08-177 (adopted July 25, 2008) ("*XM Consent Decree Order*").

¹⁰¹ *Sirius Satellite Radio, Inc., Application for Special Temporary Authority to Operate Satellite Digital Audio Radio Service Complementary Terrestrial Repeaters*, Order and Authorization, 16 FCC Rcd 16773 (Int'l Bur. 2001) ("*Sirius 2001 STA Order*"); *XM Radio, Inc., Application for Special Temporary Authority to Operate Satellite Digital Audio Radio Service Complementary Terrestrial Repeaters*, Order and Authorization, 16 FCC Rcd 16781 (Int'l Bur. 2001) ("*XM Radio 2001 STA Order*"). Since 2001, both Sirius and XM have submitted additional STA requests seeking to modify their repeater networks or to add new repeaters. A full list of SDARS STA requests are available through the International Bureau Filing System (IBFS), which is available online at <http://licensing.fcc.gov/myibfs>.

¹⁰² Sirius sought authority to operate terrestrial repeaters in Alaska and Hawaii in 2006; that request remains pending. *See Sirius Satellite Radio Inc., Request for Special Temporary Authority to Operate Four Satellite DARS Terrestrial Repeaters in Alaska and Hawaii*, IBFS File No. SAT-STA-20061107-00131, filed Nov. 11, 2006. In addition, both Sirius and XM operate terrestrial repeaters in Canada through affiliated Canadian subsidiaries, but these repeater operations are conducted pursuant to authorizations from the Canadian government, not through Commission authorizations.

¹⁰³ *See Application of Sirius XM Radio Inc. For Special Temporary Authority to Operate Twenty SDARS Terrestrial Repeaters in the Commonwealth of Puerto Rico*, IBFS File No. SAT-STA-20081027-00210, Order and Authorization, DA 09-2039, 24 FCC Rcd 11827 (rel. Sept. 11, 2009).

¹⁰⁴ Letter from Terrence R. Smith, Sr. Vice President, Technology, and James S. Blitz, Vice President, Regulatory Counsel, Sirius XM Radio Inc., to Marlene H. Dortch, Secretary, FCC (dated Nov. 13, 2008) (Sirius XM Nov. 13, 2008, *Ex Parte*) at 2.

¹⁰⁵ *Id.*

satellite feeds transmitted by the Sirius and XM platforms are not interchangeable, but instead are used in complementary fashion to overcome outages due to various signal impairments to ensure that the required service is provided to consumers.¹⁰⁶ The Sirius XM networks rely heavily on the systems' diversity aspect to deliver high quality, continuous, broadcasts to low-cost mobile receivers from distant satellites in order to avoid the need to build a large repeater network similar to the scope of terrestrial cellular communications systems.¹⁰⁷

39. *Description of Anticipated WCS Deployments.* WCS licensees have expressed a desire to deploy mobile units using WiMAX technology. Since there have not been any WCS mobile systems deployed in the United States, it is still unknown what types of mobile WCS devices and products will be widely adopted by consumers. However, in the tests they have conducted, the WCS licensees have placed an emphasis on using mobile handheld devices, such as cell phones, and data products, such as for laptop computers, to provide service. Additionally, a WiMAX network can be deployed as a cellular technology in FDD mode or TDD mode.¹⁰⁸ The WCS Coalition has indicated their preference for TDD, and asserts that a WiMAX mobile station's transmit power level in TDD mode is a function of multiple algorithms and parameters that are primarily designed to ensure that a mobile transmits at the lowest possible power level necessary in order to minimize intra-system interference and maximize battery life.¹⁰⁹ Under real-world deployment conditions, the mobile device transmit power varies dynamically over time and location. Moreover, the WCS Coalition contends that in a TDD configuration, the mobile station would transmit only during the uplink portion of a frame and only when it has packets to transmit. The length of these packets (bursts) is a function of the duty cycle (*i.e.*, how much of a transmission frame a mobile device has been allocated) and application model (traffic pattern), which is commonly biased towards the downlink. According to the WCS Coalition, the result of these factors is that the mobile station in a typical WiMAX deployment is almost always operating at power levels well below its allowable maximum.¹¹⁰

40. These SDARS and WCS system descriptions identify several points such as satellite diversity, ATPC, and duty cycle, among other things, that have been heavily debated by the parties in this proceeding. The interference modeling results considered in this proceeding are affected by the assumptions used to define the mobile device operation (and depending upon those assumptions, whether a corresponding reduction in interference levels should be assumed). In addition to the analyses and previous individual test results submitted by the parties, we also have the results of the testing Sirius XM and the WCS Coalition each conducted in Ashburn, Virginia with FCC staff and interested parties present. Below, we evaluate the potential interference that may be caused by a WCS mobile transmitter

¹⁰⁶ *Id.*

¹⁰⁷ See Sirius XM Nov. 13, 2008, *Ex Parte*. Sirius XM reiterates that the multiple satellite feeds are not for redundancy and that the loss of one feed would degrade the service received by satellite radio subscribers. It points out further its earlier objection to the proposal by the WCS Coalition to permit an out-of-band emissions (OOBE) mask for WCS mobile devices that would allow higher levels of OOBE interference at the WCS/satellite radio band edge and then require higher levels of attenuation deeper inside the satellite radio allocation.

¹⁰⁸ FDD simultaneously provides separate radio transmission channels for the mobile device and the base station, so that they both may constantly transmit while simultaneously receiving signals. With TDD, a single radio channel is used a portion of the time to transmit from the base station to the mobile device, and the remaining time is used to transmit from the mobile device to the base station.

¹⁰⁹ See WCS Coalition Comments, Attachment B, at 6.

¹¹⁰ See WCS Coalition Comments, Attachment B, at 6. Sirius XM disputes this contention. See Sirius XM *Ex Parte*, dated Sept. 8, 2008, Exhibit A at 14 ("Sirius XM Sept. 8, 2008, *Ex Parte*"), citing a trade magazine article: Poulin, Darcy, "How to meet the design challenges of WiMAX power amplifiers," Embedded.com, (June 10, 2008) available at <http://www.embedded.com/design/208403248>.

located in a vehicle to an SDARS receiver located in another nearby vehicle and base our decisions, in large part, on the results of the Ashburn testing.

C. WCS Mobile and Portable Device Power Limits

41. *Background.* As noted above, the current rules permit WCS mobile transmitters to operate with up to 20 W of power. However, the WCS licensees claim that no WCS mobile transmitters have been deployed because the out-of-band emissions limit of -110 dBW for WCS mobile devices in the SDARS band cannot viably be met in a mobile transmitter.¹¹¹ Thus, two fundamental issues must be considered relative to WCS mobile transmitter power as we consider revisions to the rules that would facilitate deployment of mobile WCS operations. First, there exists a potential for overload interference to the SDARS receiver that could be caused by a WCS mobile device operating in close proximity, both physically and in terms of frequency separation. Overload occurs when a receiver is unable to reject excessive energy outside its intended frequency band of operation. The second issue, which is equally important, is the effect of the power limit on the viability of the WCS mobile service. As the power level of the mobile device is reduced, the number of required base stations increases, which can make the system impractical and uneconomical to deploy.

42. Sirius XM argues that, in order to protect satellite radio consumers from WCS interference, the Commission should retain the current technical restrictions on WCS mobile and portable devices for WCS Blocks C and D.¹¹² Sirius XM claims that no WCS mobile or portable devices can operate on WCS Blocks C and D without causing harmful interference to satellite radio devices and argues that only WCS fixed operations should be allowed in WCS Blocks C and D.¹¹³ For WCS mobile and portable devices operating in WCS Blocks A and B, however, in September 2009, Sirius XM proposed a power limit of 125 mW.¹¹⁴

43. The WCS Coalition proposes that WCS mobile and portable devices operating in WCS Blocks A and B be permitted to use an average EIRP of 250 mW.¹¹⁵ For WCS Blocks C and D, the WCS Coalition proposes mobile and portable device EIRP limits of 50 mW/MHz (*i.e.*, 150 mW per 3 megahertz) between the 2315-2318 and 2347-2350 MHz portions of the C and D blocks, and

¹¹¹ See WCS Coalition Comments at 5.

¹¹² See Sirius XM Sept. 3, 2009, *Ex Parte* presentation at 27. See also Sirius XM Sept. 8, 2008, *Ex Parte* at 3. Sirius XM initially proposed limiting mobile and portable devices operating in WCS blocks C and D to 1 mW EIRP. See Sirius Comments at 34; XM Comments at 31.

¹¹³ See Sirius XM Sept. 3, 2009, *Ex Parte* presentation at 27.

¹¹⁴ *Id.* Sirius XM initially proposed a limit of 10 mW EIRP for WCS mobile and portable devices operating in WCS Blocks A and B.

¹¹⁵ See WCS Coalition *Ex Parte* presentation (dated Oct. 7, 2009) at 3. Previously, the WCS Coalition proposed that all WCS mobile and portable devices that comply with its proposed out-of-band emissions limit should be allowed to transmit with an average EIRP of 250 mW. See Letter from Paul J. Sinderbrand, Counsel to the WCS Coalition, to Marlene H. Dortch, Secretary, FCC (dated July 22, 2008), at 4 (“WCS Coalition July 22, 2008, *Ex Parte*”). The WCS Coalition also proposed that WCS mobile and portable devices should be required to employ automatic transmitter power control (ATPC), which would generally reduce the EIRP to levels below the proposed 250-mW average EIRP. See WCS Coalition July 22, 2008, *Ex Parte* at 4. NextWave suggested that WCS Blocks C and D mobile and portable devices be limited to 150 mW in the 2315-2318 and 2347-2350 MHz sub-bands and to 60 mW in the 2318-2320 and 2345-2347 MHz sub-bands. See Letter from Jennifer M. McCarthy, Vice President, Regulatory Affairs, NextWave Wireless Inc., to Marlene H. Dortch, Secretary, FCC (dated Nov. 16, 2008) (“NextWave Nov. 16, 2008, *Ex Parte*”) at 2, and Letter from Jennifer M. McCarthy, Vice President, Regulatory Affairs, NextWave Wireless Inc., to Marlene H. Dortch, Secretary, FCC (dated Nov. 26, 2008) (“NextWave Nov. 26, 2008, *Ex Parte*”) at 3.

30 mW/ MHz between the 2318-2320 and 2345-2347 MHz portions of the C and D blocks (*i.e.*, 60 mW per 2 megahertz). The WCS Coalition believes that there will be little or no muting of the SDARS signal from WCS mobile and portable devices operating with these EIRP limits.¹¹⁶

44. *Measurements and Technical Analyses.* Sirius, XM, and the WCS Coalition each conducted individual measurements and technical analyses to support their proposed WCS power levels in their initial comments. Sirius and XM originally conducted tests with an SDARS receiver using an antenna mounted on the roof of a vehicle and a WiMAX signal generator connected to an antenna mounted at a height of 2 meters and attached to a cart so that the separation distance could be varied. Sirius claims the tests it conducted indicated that overload interference that would block reception of (*i.e.*, mute) the SDARS satellite signals would occur at a distance of up to 34 meters from a 250 mW WCS signal in the C block and at a distance of up to about 20 meters from a 250 mW WCS signal in the A and B blocks.¹¹⁷ XM claims the tests it conducted indicated that overload interference that would mute the SDARS satellite signals would occur at a distance of up to 16 meters from a 112 mW WCS signal in the D block and a distance of up to about 13 meters from a 112 mW WCS signal in the A and B blocks.¹¹⁸ Sirius' tests also showed that interference to the SDARS terrestrial signals would occur at a distance of up to approximately 23 meters from a 250 mW WCS signal in the C block and at a distance of up to approximately 15 and 18 meters from a 250 mW WCS signal in the A and B blocks, respectively.¹¹⁹

45. The WCS Coalition originally conducted tests of overload interference only for the WCS A and B blocks. For this testing, an SDARS antenna was mounted on the roof of a vehicle 48 inches from the rear bumper of the vehicle. Out-of-vehicle tests used a WCS WiMAX consumer premises equipment (CPE) device positioned in the same horizontal plane as the roof-mounted SDARS antennas at varying distances. In-vehicle tests used WCS WiMAX CPE positioned inside the same vehicle containing the SDARS equipment positioned either in the front passenger seat or the rear passenger seat. During this testing, the WCS Coalition found that muting occurred at distances of 3 meters or less. The WCS Coalition submits that these tests showed that in typical satellite-only coverage, the WCS CPE devices induced muting at distances of 2 to 13 feet outside the vehicle. The Sirius receiver experienced muting at 4 feet with the WCS WiMAX CPE at 250-mW average EIRP, and at 2 feet with the CPE at 100-mW average EIRP. The XM receiver experienced muting at 10 to 13 feet with the WCS WiMAX CPE at 250-mW average EIRP, and at 7 to 10 feet with the CPE at 100-mW average EIRP. With the WiMAX CPE antenna inside the vehicle, only one instance of muting of the XM receiver occurred with the WiMAX antenna inside the same vehicle as the XM antenna and directly below it.¹²⁰

46. There were a number of differences between the SDARS and WCS tests, such as the power levels, bandwidths, duty cycle of the WCS signal, and various combinations WCS frequency blocks. Much of the disagreement relative to potential overload interference also stems from different findings about the path loss as a signal propagates between a WCS mobile device and an SDARS mobile receiver. The WCS Coalition and Sirius XM both measured and modeled the propagation path loss from a WCS mobile device to an SDARS mobile receiver input – with the SDARS antenna situated atop a car

¹¹⁶ See WCS Coalition Oct. 7, 2009, *Ex Parte* presentation at 3 and 15.

¹¹⁷ See Sirius Comments, Exhibit C at C8.

¹¹⁸ XM Comments, Exhibit C, at 8 and 9. We note that these distances are equivalent to distances of 24 meters from a 250-mW WCS signal in the D block and 20 meters from a 250-mW WCS signal in the A and B blocks, given the square root relationship between distance and power. (*I.e.*, under Free Space Loss conditions, the ratio of two distances is equal to the square root of the ratio of the two powers involved.)

¹¹⁹ See Sirius Reply Comments at 13.

¹²⁰ See WCS Coalition *Ex Parte* dated May 9, 2008, WCS Test Report at 3-10.

with a clear line of sight to the WCS transmit antenna – and obtained different results.¹²¹ The WCS Coalition determined the path loss in decibels (dB) to be $(50.9 + 21.8 \log(D_{\text{meters}}))$ dB, which is approximately equal to Free Space Loss (FSL) + 12 dB at 3 meters, whereas Sirius XM determined the loss to be $(42.8 + 20 \log(D_{\text{meters}}))$ dB, or FSL + 3 dB, which is 9-dB lower than the WCS Coalition’s determination. Sirius XM and the WCS Coalition each reference various technical papers in support of their respective positions on the appropriate path loss.¹²²

47. The WCS Coalition also made measurements to evaluate the additional attenuation for the case when a WCS mobile device is held against the user’s head or lap while a user is sitting inside of a vehicle. From these measurements, the WCS Coalition found that there was a combined additional attenuation ranging from 4.8 dB to over 14.1 dB.¹²³ In this testing, to determine the additional losses expected when a WCS transmitter is operated in a vehicle and an SDARS receiver is in a different vehicle or the same vehicle, the WCS Coalition placed the WCS test device inside a vehicle in a manner which also incorporated head and body losses associated with use of the WCS device.¹²⁴ The WCS Coalition explains that the basic test set-up was the same as with previous testing, *i.e.*, from the input of the transmit antenna to the output of the SDARS receive antenna, on paths of varying distances, though now obstructed by head and body and vehicle losses.¹²⁵ The position of the WCS test transmitter was varied between front and rear seats, left and right seats, ear and lap heights, with the WCS transmitting vehicle behind and in front of the SDARS receive vehicle, and with the WCS transmitter and SDARS receiver in the same vehicle.¹²⁶ The position of the SDARS test receiving antenna mounting is similarly varied between the front and rear of the roof of the vehicle, on the centerline of the roof, representative of OEM installations. The WCS Coalition explains that a total of 20 scenarios were measured, each with multiple frequency sweeps, with path distances varying from 4.4 to 7.2 meters to represent vehicles stopped at a traffic signal or in traffic.¹²⁷ The WCS Coalition calculates and displays the median measured path loss results for the various separation distances, then subtracts the WCS Coalition Propagation Model (WPM) path losses calculated for those distances, to arrive at the additional path losses by which these measured path losses exceed the unobstructed WPM model path losses: 4.8 to 14.1 dB.¹²⁸ The WCS Coalition attributes these additional losses primarily to shielding of the WCS transmit antenna by the vehicle in

¹²¹ See WCS Coalition Reply Comments, Attachment B; Sirius Comments, Exhibit C.

¹²² Sirius XM frequently refers to a paper presented by a member of the staff of the National Telecommunications and Information Administration at an Institute of Electrical and Electronics Engineers Vehicular Technology Society Conference entitled “Propagation for Mobile-to-Mobile Communications.” See, *e.g.*, Sirius Reply Comments at 23. The WCS Coalition responds in its May 9, 2008, *Ex Parte* filing that Sirius XM’s conclusion is flawed because it is based on a computational error and further, the findings of this study are based on free-standing antennas and follow free space loss. The WCS Coalition goes on to cite other papers that it contends support higher path losses for situations similar to the one at issue here where the SDARS receiving antenna is located on a ground plane (the roof of a vehicle). See WCS Coalition May 9, 2008, *Ex Parte* at 7-9

¹²³ See Letter from Mary N. O’Connor, Counsel to the WCS Coalition, to Marlene H. Dortch, Secretary, FCC (dated Aug. 1, 2008)(WCS Coalition Aug. 1, 2008, *Ex Parte*).

¹²⁴ *Id.*, Attachment at 4 and 7.

¹²⁵ *Id.*, Attachment at 4.

¹²⁶ *Id.*, Attachment at 3 and 6-8.

¹²⁷ *Id.*, Attachment at 8-11.

¹²⁸ *Id.*, Attachment at 14. The WCS Coalition measured the path loss between a WCS transmitting antenna and an SDARS receiving antenna on a vehicle at various separation distances and found the path loss to be $50.9 + 21.8 \log(D_{\text{meters}})$ dB (WCS Coalition Propagation Model, or WPM) for distances from 5 feet to 50 feet (1.5 to 15 meters). See ¶¶ 90-91, *infra*.

which it is located from the external, roof mounted SDARS receive antenna, to head and body losses, and to other propagation factors.¹²⁹

48. The WCS Coalition and the SDARS licensees also offer different assessments as to the capabilities of SDARS receivers to reject overload interference. Sirius XM claims that a received interfering power level of -44 dBm from WCS operations in Blocks A and B and interfering power of -55 dBm from WCS operations in Blocks C and D will cause muting of the SDARS receiver.¹³⁰ According to the WCS Coalition, however, some SDARS receivers have a very steep front end filter roll-off (*i.e.*, attenuation of adjacent-bands' signals) and are therefore better able to reject overload interference.¹³¹

49. Furthermore, the WCS Coalition and the SDARS licensees provide different assessments of the likelihood of receiver overload interference. The WCS Coalition argues that interference is highly unlikely and would require the coincidence of a variety of conditions to occur: both devices are operating in close geographic proximity and are stationary relative to one another; the WCS device is transmitting and operating at or near the maximum permitted power; no obstructions exist between the transmitter and receiver; there is good coupling between the antennas; and the WCS and SDARS devices are operating in adjacent frequency bands.¹³² The WCS Coalition underscores that mobile handsets would operate at or close to their maximum power only rarely and will operate at 3-4 dB¹³³ less power 99 percent of the time.¹³⁴ Sirius XM denies each of these points claiming that devices will often be in close proximity, the devices will be side by side and stationary in heavy traffic, and there will be a high degree of antenna coupling as reflected in its testing.¹³⁵ Sirius XM also disputes the WCS Coalition's claim that WCS devices will operate at 3-4 dB below maximum power 99 percent of the time and asserts that the WCS device will often operate at its maximum power to achieve the highest available data rate.¹³⁶ Sirius XM claims that based on its analysis, up to 13 percent of SDARS users will experience interference in early deployment of WCS and up to 24 percent in later stages of deployment.¹³⁷ NextWave, a WCS licensee, disputes the basis for this analysis and counters that the predictions of interference are grossly inflated due to inappropriate assumptions, such as no consideration of ATPC or the required separation distances for vehicles located in the same traffic lane.¹³⁸ Sirius XM responds that the WCS Coalition's analysis is

¹²⁹ *Id.*, Attachment at 13 and 14.

¹³⁰ See Sirius Comments, Exhibit C.

¹³¹ See WCS Coalition Comments at 11, n.24, and Attachment A. See also WCS Coalition May 19, 2008, *Ex Parte* at 7.

¹³² See WCS Coalition Comments, Attachment B at 19; see also, *e.g.*, WCS Coalition *Ex Parte* filing dated May 5, 2008.

¹³³ A 3-dB reduction equates to reducing the transmitted power by one-half.

¹³⁴ See WCS Coalition Comments, Attachment B at 19.

¹³⁵ See Letter from Patrick L. Donnelly, Executive Vice President, General Counsel & Secretary, Sirius Satellite Radio Inc., and James S. Blitz, Vice President and Regulatory Counsel, XM Radio Inc., to Marlene H. Dortch, Secretary, FCC (dated May 9, 2008) (Joint Sirius/XM May 9, 2008, *Ex Parte*), Attachment at 35.

¹³⁶ See Letter from James S. Blitz, Vice President, Regulatory Counsel, Sirius XM Radio, Inc., to Marlene H. Dortch, Secretary, FCC (dated Sept. 8, 2008) (Sirius XM Sept. 8, 2008, *Ex Parte*) at 4, 13, and 14.

¹³⁷ See Letter from Robert L. Pettit, Counsel to Sirius XM Radio, Inc., to Marlene H. Dortch, Secretary, FCC (dated Oct. 2, 2008) (Sirius XM Oct. 2, 2008, *Ex Parte*).

¹³⁸ See Letter from Jennifer M. McCarthy, Vice President, Regulatory Affairs, NextWave Wireless Inc., to Marlene H. Dortch, Secretary, FCC (dated Nov. 16, 2008) (NextWave Nov. 16, 2008, *Ex Parte*), Technical Analysis at 4.

predicated on assumptions about the specific technologies that will be used and business plans that will be implemented, which cannot be assured.¹³⁹

50. *Princeton, NJ Tests.* In January of 2009, Sirius XM tested a WCS device's potential to cause interference to SDARS operations in Princeton, New Jersey. Sirius XM reported that it chose this location for the testing because it receives strong satellite signals with minimal terrestrial repeater coverage on the test route. As part of the test, Sirius XM outfitted one vehicle with test equipment that generated a mobile WiMAX waveform in various WCS sub-bands and an in-vehicle antenna, and a second vehicle with Sirius and XM satellite radio receivers and typical roof-mounted antennas. Sirius XM tested the generated WiMAX test signals in the WCS D block at 150 mW transmit power and an OOB attenuation of $55 + 10 \log (P)$ dB at the SDARS band edge, in the WCS C block at 150 mW transmit power and an OOB attenuation of $60 + 10 \log (P)$ dB at the SDARS band edge, and in the lower WCS B block (*i.e.*, 2310-2315 MHz) at 250 mW transmit power and an OOB attenuation of $60 + 10 \log (P)$ dB at the SDARS band edge.¹⁴⁰

51. During the testing, Sirius XM monitored an XM upper-ensemble channel¹⁴¹ and a Sirius channel for muting while testing three different WCS use cases – handheld, laptop, and dashboard installation – to simulate the WCS Coalition's proposal for the WCS band emission levels. Specifically, Sirius XM tested WCS handheld use in the WCS D, C, and B (lower) blocks, and laptop and dashboard use in the WCS C block. Sirius XM reported that it observed severe interference from the WCS signal for long durations over large distances and in typical traffic patterns. Sirius XM also reported that interference occurred in typical mobile conditions where the satellite receivers had a clear view of the sky without any obstructions. In addition, Sirius XM reported that the WCS mobile devices caused interference in areas near Princeton where repeater coverage was present. In its report, however, Sirius XM did not specify whether the WCS interference was attributable to overload or OOB interference.¹⁴²

52. The WCS Coalition filed *ex parte* comments on Sirius XM's testing in New Jersey after a meeting with Sirius XM representatives and Commission staff regarding the testing.¹⁴³ In its filing, the WCS Coalition alleged flaws in the testing that it contends had led Sirius XM to claim that its SDARS receivers are vulnerable to interference from WCS mobile operations. Specifically, the WCS Coalition argues in its March 9, 2009, *ex parte* filing that the testing Sirius XM conducted did not reflect "real world" operating conditions for the WCS transmitters. As an initial matter, the WCS Coalition states that Sirius XM did not employ the stepped OOB limits that the WCS Coalition has proposed for all mobile devices, which Sirius XM confirmed was true during the meeting. Also, the WCS Coalition noted that Sirius XM stated that the mobile device it used during the testing did not employ ATPC, which the WCS Coalition has proposed be required for all WCS mobile devices.¹⁴⁴ We note also Sirius XM recently

¹³⁹ See Letter from Terrence R. Smith, Chief Engineering Officer, and James S. Blitz, Vice President, Regulatory Counsel, Sirius XM Radio Inc., to Marlene H. Dortch, Secretary, FCC (dated Nov. 20, 2008) (Sirius XM Smith/Blitz Nov. 20, 2008, *Ex Parte*) at 4 (summarizing a meeting with Commission staff on Nov. 16, 2008).

¹⁴⁰ See Sirius XM *Ex Parte* dated February 10, 2009. Sirius XM used a "flat mask" of $60 + 10 \log (P)$ dB, rather than the WCS Coalition's proposed stepped mask, because, it contends, two WCS Coalition members – Nextwave Wireless and Horizon Wi-Com – believe that such a mask is roughly equivalent to the WCS Coalition's stepped mask and is therefore an acceptable alternative to the stepped mask. See Sirius XM *Ex Parte* dated April 8, 2009, at 3.

¹⁴¹ In the XM network, each of the two XM satellite and terrestrial repeater sub-bands are divided into separately transmitted lower ensemble signals and upper ensemble signals.

¹⁴² See Sirius XM *Ex Parte* dated February 9, 2009.

¹⁴³ See WCS Coalition *Ex Parte* filing dated March 9, 2009, at 2.

¹⁴⁴ *Id.*

submitted an *ex parte* video that contends demonstrates harmful interference will occur to SDARS receivers under the WCS rules proposed in the *WCS/SDARS Technical Rules Public Notice*.¹⁴⁵ The WCS Coalition believes that the demonstration is not representative of how an actual mobile WiMAX system will perform, but instead, was designed and implemented to maximize potential interference.¹⁴⁶

53. In addition, the WCS Coalition stated that Sirius XM also stated that it did not conduct any testing over the A block or upper B block channels, which it concedes are less likely to interfere with SDARS operations. The WCS Coalition further noted that Sirius XM stated that the test transmitter used in New Jersey was operated with a 25-percent duty cycle, which the WCS Coalition contends is not representative of how a WCS mobile would likely operate.¹⁴⁷ Instead, as the WCS Coalition subsequently noted, a duty cycle of at least 35 percent would be needed to facilitate the provision of a viable broadband service.¹⁴⁸ During the meeting, Sirius XM also conceded that it did not conduct the tests in a manner that would permit the Commission to determine how much, if any, of the purported interference actually was caused by OOB. As a result, the WCS Coalition contends, the testing did not illustrate the need for the onerous OOB restrictions that have been proposed by Sirius XM. The WCS Coalition also contends that Sirius XM implemented its test setup in such a manner that leakage from the power amplifier could have been a material contributor to the interference.¹⁴⁹

54. In light of these differences, Sirius XM urged the Commission to require additional testing be performed by a third party or under Commission supervision that would examine various combinations of conditions, including different SDARS receivers, an actual WCS mobile device, multiple vehicles, stationary vehicles, and vehicles in motion.¹⁵⁰ The WCS Coalition agreed to conduct further tests with Sirius XM and FCC staff present during the testing. Consequently, on July 28 and 29, 2009, in Ashburn, VA, Sirius XM and the WCS Coalition, with FCC staff present, each conducted testing of a WCS signal's potential to interfere with the reception of Sirius XM's SDARS transmissions.¹⁵¹ The WCS Coalition performed its testing on July 28 and Sirius XM performed its testing on July 29.¹⁵²

55. *Ashburn, VA Tests.* During the tests it performed in Ashburn, the WCS Coalition demonstrated actual WiMAX equipment under several use scenarios. Sirius XM states that the WCS Coalition's Ashburn testing demonstrates that a certain configuration of mobile WCS devices that are operated under specific usage patterns will cause only limited interference to the reception of Sirius XM's signal. Sirius XM also states that although the operating parameters were not fully transparent, the WCS mobile device's signal transmitted at a variety of operating powers and WCS frequencies generally did

¹⁴⁵ See Sirius XM *Ex Parte* filing dated May 6, 2010 at 2.

¹⁴⁶ See WCS Coalition *Ex Parte* Presentation dated May 12, 2010, at 1-2.

¹⁴⁷ See WCS Coalition *Ex Parte* filing dated March 9, 2009, at 2. The WCS Coalition subsequently stated that it is common for commercial WiMAX systems to allocate approximately 38 percent of each frame to uplink (*i.e.*, user device) transmissions. See WCS Coalition *Ex Parte* filing dated March 31, 2010, at 2.

¹⁴⁸ See WCS Coalition *Ex Parte* filing dated January 29, 2010, at 4.

¹⁴⁹ See WCS Coalition *Ex Parte* filing dated March 9, 2009.

¹⁵⁰ See Sirius XM *Ex Parte* filings of May 9, 2008, May 19, 2008, May 20, 2008, June 4, 2008, June 13, 2008, June 16, 2008, and July 2, 2008.

¹⁵¹ We refer to these tests henceforth as the "Ashburn tests," "Ashburn testing," or "testing in Ashburn."

¹⁵² See Sirius XM *Ex Parte* filing dated August 3, 2009, and WCS Coalition *Ex Parte* filing dated August 4, 2009. See also WCS Coalition *Ex Parte* filing dated August 4, 2009. FCC staff from the Commission's Office of Engineering and Technology, the International Bureau, and the Wireless Telecommunications Bureau observed the Ashburn, VA testing sessions. For a detailed description of the testing, see Appendix E.

not mute Sirius XM's audio channel signal in the other test vehicle.¹⁵³ Sirius XM believes its own Ashburn testing demonstrates how different mobile WCS configurations and use cases (such as those proposed by the WCS Coalition) would cause muting of Sirius XM's signal, even at transmitter/receiver separation distances greater than 25 meters and in the presence of a Sirius XM terrestrial repeater. During its testing, Sirius XM used test equipment to simulate WiMAX operations. Although Sirius XM believes its testing showed that some mobile use of the WCS spectrum could be allowed, it believes that such use must be strictly controlled and limited to certain technologies and test cases that can be demonstrated not to prevent reception of the SDARS signal.¹⁵⁴

56. The WCS Coalition states that its testing in Ashburn demonstrated that WCS interference to SDARS will occur only in the rarest of real-world circumstances if the WCS Coalition's proposed rules for WCS are adopted, especially given that there was only one instance of muting of the SDARS receiver during the WCS Coalition's drive testing. The WCS Coalition also contends that Sirius XM's testing in Ashburn was not realistic and did not reflect how any practical two-way broadband system would operate on the WCS frequencies. Specifically, the WCS Coalition believes that the SDARS muting that resulted from Sirius XM's use of a 5-megahertz WiMAX carrier in the WCS D block that was immediately adjacent to the SDARS band edge is a worst-case scenario that would not occur with an operating WCS system. The WCS Coalition states that it is unrealistic to expect an operational WCS two-way broadband system to operate a full 5-megahertz carrier in the WCS C and D blocks because the resultant filter that would be necessary to meet the proposed OOB limits would be too large to include in a mobile device. In summary, the WCS Coalition believes that the testing demonstrated that out-of-band emissions interference from a WCS mobile device into an SDARS receiver will only occur under worst-case artificial conditions.¹⁵⁵

57. FCC staff observed Sirius XM's test using test equipment to generate a WiMAX signal and the WCS Coalition test using an actual WCS device communicating with a WCS base station. Both individual tests were conducted while the simulated and actual WCS end-user device was operating in close geographic proximity to an original equipment manufacturer (OEM) and aftermarket SDARS receiver. FCC staff observed that test scenario employed by Sirius XM's signal generator produced a five-megahertz-wide WiMAX carrier in the WCS D block, immediately adjacent to the SDARS band edge, which produced several instances of SDARS muting. Staff observed too that when Sirius XM moved its test WCS signal two megahertz away from the SDARS band edge, only slight muting of the SDARS signal occurred.

58. During the WCS Coalition's testing, drive tests were performed for a total of six WCS mobile device configurations; each configuration was tested at least once, and a few of the configurations were tested two or more times. No muting was observed when the edge of the WCS signal was separated from the SDARS band by 5 megahertz. Although the staff observed in one instance that the SDARS signal was muted when the WCS mobile device was being operated with a 250 mW EIRP over 5 megahertz, ATPC employed, and a 2.5-megahertz guard band between the WCS signal and the SDARS band, during the remainder of the WCS Coalition's testing with these same operating conditions, no muting of the Sirius or XM signal was observed even though there were hundreds of instances during the drive tests when conditions were such that interference could have occurred.¹⁵⁶ Significantly, no muting

¹⁵³ See Sirius XM *Ex Parte* filing dated August 3, 2009, at 3-4.

¹⁵⁴ *Id.*

¹⁵⁵ See WCS Coalition *Ex Parte* filing dated August 4, 2009, at 1-2.

¹⁵⁶ During the drive tests conducted in the two sedans rented by the WCS Coalition, FCC staff saw only a short interval of satellite radio receiver muting during one test scenario, at a single location on the route, with the XM original equipment manufacturer (OEM) satellite radio receiver. In this occurrence, the WiMAX link was operating with a 5-megahertz-wide signal comprised of 2.5-megahertz portions each of WCS Blocks D and A, the traffic

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occurred even when the WCS mobile device was operating at full power without ATPC employed, with the EIRP fixed at 24 dBm (*i.e.*, 250 mW) over 5 megahertz. Moreover, although the WCS Coalition's tests showed that in a vehicular-mobile environment, muting could occur when the devices are within 3 meters of one another, the WCS device is transmitting with ATPC activated, only one SDARS satellite is visible, only one satellite channel is available, and no terrestrial repeater is present at that same moment, the tests showed muting is not inevitable in every instance when a WCS mobile or portable device is in close proximity to an SDARS receiver.

59. *Comments.* In its comments on the Commission staff's proposed interference rules in the *WCS/SDARS Technical Rules Public Notice*, Sirius XM contends that the power limit for WCS mobile and portable devices should be reduced to 150 mW average EIRP in the WCS C and D blocks, recognizing that NextWave and Horizon previously informed the Commission that 150 mW, along with a power density of 50 mW/MHz, should provide additional interference protection to Sirius XM but would still enable WCS C and D block licenses to offer a viable two-way broadband service.¹⁵⁷ Sirius XM further contends that the Commission should adopt a variable duty cycle limit ranging from 12.5 to 35 percent for WCS mobile and portable devices, depending on the spectrum block, as in the Commission staff's recommended proposals shared with the licensees on March 2, 2010,¹⁵⁸ and that the rules should specify a duty cycle measurement frame of 5 milliseconds (ms). Sirius XM further argues that the power level and duty cycle limitations would be controlled by the network and would require no special design modifications for WCS mobile devices that would defeat standardization or otherwise delay deployment.¹⁵⁹ In addition, Sirius XM states that a reduction in the frame repetition rate from transmissions every 5-ms frame to transmissions every other frame (*i.e.*, activity over 10 ms) would significantly decrease the potential for interference into an SDARS receiver from a WCS WiMAX signal because there would not be any activity in consecutive transmit frames for any mobile device.¹⁶⁰ Sirius XM also repeats its suggestion that the Commission set a ground-level emission limit of -44 dBm per 100 meters on major and secondary roads.¹⁶¹ Sirius XM further argues that WCS rules should establish a maximum occupied bandwidth of 5 megahertz because WCS transmissions that occupy 10 or 12.5-megahertz-wide channels would have a greater potential to interfere with SDARS receivers.¹⁶² In a subsequent filing, a consultant for Sirius XM, Dr. Theodore S. Rappaport, P.E., recommends that WCS

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generation software was performing a high-data-rate upload from the mobile device to the base station, and the WiMAX mobile device, with ATPC turned on, was being held at lap height. No muting was observed for two additional tests of a WCS signal composed of 2.5-megahertz portions of WCS Blocks D and A, when the 5-megahertz-wide WCS signal was centered in the lower WCS B block (*i.e.*, 2310-2315 MHz), or that was composed of 2.5-megahertz portions each of WCS Blocks B and C (*i.e.*, 2312.5-2317.5 MHz).

¹⁵⁷ See Comments of Sirius XM, filed Apr. 23, 2010, at 31.

¹⁵⁸ On March 2, 2010, staff from the Commission's Office of Engineering and Technology, the International Bureau, and the Wireless Telecommunications Bureau met with representatives from Sirius XM and the WCS Coalition to discuss its recommended proposals for 2.3 GHz WCS mobile and portable devices' power and OOB limits that included a 2.5-megahertz WCS guard band, relaxed OOB limits for WCS mobile and portable devices, and a stepped maximum duty cycle requirement that would place greater restrictions on WCS mobile and portable devices in the WCS blocks closest to the SDARS band than on those devices operating in WCS blocks further removed from the SDARS band. Specifically, the Commission staff's proposal included setting the maximum duty cycle for WCS mobile and portable devices at 12.5 percent in the 2.5-megahertz portions of the WCS C and D blocks furthest from the SDARS band, at 25 percent in the inner WCS A and B blocks, and at 35 percent in the outer WCS A and B blocks.

¹⁵⁹ *Id.* at 30-31.

¹⁶⁰ *Id.* at 30-31 and Appendix A, 7-8.

¹⁶¹ See Comments of Sirius XM Radio Inc., filed April 23, 2010, at 32.

¹⁶² *Id.* at 35.

mobile and portable devices' EIRP be limited to 100 mW per 2.5 megahertz and that a 2.5-megahertz guard band be established between the WCS and SDARS band edges. Dr. Rappaport believes this power limit would provide sufficient protection to SDARS receivers while allowing WCS licensees to build out a viable terrestrial mobile network.¹⁶³

60. In its *Ex Parte* Letter of March 15, 2010, the WCS Coalition states that if the Commission were to adopt a graduated duty cycle ranging from 12.5-35 percent, and A and B block licensees simultaneously employed the outer 2.5 megahertz of the C or D block along with the A or B blocks to provide for mobile handoffs, the duty cycle of all the channels would be reduced to the lowest duty cycle of 12.5 percent. However, the WCS Coalition contends that the 12.5 percent duty cycle is not supported by any fourth generation (4G) wireless communications standard. The WCS Coalition also argues that the 5 ms frame for measuring the duty cycle was for a specific WiMAX protocol and that other 4G standards utilize other frame rates. To maintain technology neutrality, the WCS states that any duty cycle specification should be tied directly to the frame duration of the technology in use.¹⁶⁴ In its comments on the Commission staff's proposed interference rules, the WCS Coalition states that although the proposed power limits will not preclude the deployment of viable mobile broadband services, the proposed technical rules are not the optimum from the perspective of one hoping to utilize the WCS spectrum.¹⁶⁵ However, Wolfhard J. Vogel, Ph.D., a satellite radio engineer, believes that to prevent interference to SDARS receivers, WCS mobile devices should be limited to a duty cycle of 12.5 percent.¹⁶⁶ On the other hand, Horizon Wi-Com, LLC (Horizon), a WCS licensee, disputes Sirius XM's assertion that using every other 5-ms frame for mobile device transmissions would be consistent with current technology. Horizon submits that, in reality, a TDD frame consists of the complete cycle of base station transmissions, transmit guard time, mobile station transmissions, and receive guard time, not simply the portion of time in which a given device transmits. Horizon argues that requiring WCS mobile devices to remain silent during every other transmit sub-frame would reduce the duty cycle for a WiMAX system to 19 percent and cut the throughput capacity of the system in half, depriving subscribers of adequate two-way speeds. As a result, Horizon contends, WCS would be precluded from providing broadband services and from becoming a viable competitor in the marketplace.¹⁶⁷

61. The Telecommunications Industry Association (TIA) believes that the Commission staff's proposals will adequately protect SDARS and AMT operations, but recommends that the Commission abandon any WCS limitations based on duty cycle. If the Commission does impose duty cycle limits, however, TIA contends that the Commission must ensure that these limits allow WCS operations in a manner that enables service and device provision, and it should reconcile the discrepancy between the proposed FDD and TDD duty cycle limits.¹⁶⁸ Ericsson Inc. (Ericsson) believes that, in order to avoid conflicts with the standards of Time Division-LTE¹⁶⁹ (TD-LTE) and other technologies, the

¹⁶³ See "Technical Analysis of the Impact of Adjacent Service Interference to the Sirius XM Satellite Digital Audio Radio Services (SDARS)" by Theodore S. Rappaport, P.E., TELISITE Corp., submitted with Supplemental Comments of Sirius XM, filed April 29, 2010, at 73.

¹⁶⁴ See WCS Coalition Mar. 15, 2010, *Ex Parte* Letter at 2.

¹⁶⁵ See Comments of the WCS Coalition, filed April 23, 2010, at 4-5.

¹⁶⁶ See Wolfhard J. Vogel, Ph.D., President, Balcones Industrial R&D Corp., comments, filed April 21, 2010, at 3.

¹⁶⁷ See Horizon Wi-Com May 12, 2010, *Ex Parte* Letter at 2-3.

¹⁶⁸ See Comments of the Telecommunications Industry Association, filed April 23, 2010, at 2-4.

¹⁶⁹ LTE (Long Term Evolution) is a new high performance wireless broadband technology developed by the Third Generation Partnership Project (3GPP), an industry trade group. LTE, which supports both FDD and TDD modes of operation, is based on Orthogonal Frequency Division Multiple Access (OFDMA) and uses Internet Protocol (IP) packets rather than a proprietary packet structure. LTE provides a framework for increasing data rates and overall

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Commission should not specify any duty cycle limit. Ericsson contends that a network that can match the uplink and downlink needs of users will use spectrum more efficiently, while placing the fewest constraints on user data rates. If the Commission nevertheless adopts a maximum uplink duty cycle, Ericsson argues that it should select a limit that imposes the fewest constraints on standards-based technologies. Considering TD-LTE networks, Ericsson believes the minimum ideal duty cycle level would be set above 63.333 percent to permit the use of all the current TD-LTE uplink-downlink configurations. At the least, Ericsson argues, the minimum duty cycle should be raised above 43.333 percent, which corresponds to the 3:2 downlink-uplink ratio of TD-LTE configuration 1, which is considered to be typical in many TDD networks and most appropriate for networks with nearly symmetrical traffic.¹⁷⁰ Alcatel-Lucent shares Ericsson's concerns about the need to accommodate the 43.3-percent duty cycle for TD-LTE, and notes that the proposed limitations on FDD duty cycles could preclude FD-LTE in the WCS band. Alcatel-Lucent contends that the Commission should refrain from imposing duty cycle limitations to allow the greatest flexibility for WCS operators to maximize network efficiency and capacity.¹⁷¹ In addition, Alcatel-Lucent submits that the Commission should reject Sirius XM's proposal to preclude mobile transmissions during every other frame, which would cut the uplink speeds in half, and is not supported by any standard technology in existence.¹⁷² Alcatel also states that so there is no impact on existing WCS point-to-point operations, the Commission should not bar WCS fixed stations from transmitting in the 2305-2320 MHz band.¹⁷³ In its May 12, 2010, *Ex Parte* presentation, the WCS Coalition states that the Commission should not adopt any duty-cycle limitations, but if deemed necessary, the duty cycle should be at least 43.333 percent to accommodate the use of TD-LTE technology.¹⁷⁴

62. *Discussion.* As an initial matter, our objective here is not to eliminate all interference, but rather eliminate the potential for harmful interference – which we define as interference that repeatedly disrupts or seriously degrades service. Upon careful review and consideration of all of the information in the record, including the various analyses and test results, we conclude that an average power level of 250-mW EIRP over 5 megahertz (50 mW/MHz) accompanied by ATPC and a duty cycle limit of 38 percent is appropriate for mobile and portable devices operating in the WCS A and B blocks and the 2.5-megahertz portions of the WCS C and D blocks furthest removed from the SDARS band (*i.e.*, 2305-2317.5 and 2347.5-2360 MHz). Assessing the likelihood of interference from WCS to SDARS is an extremely complex exercise because there are many variables involved and there is considerable variability in each of the underlying assumptions. There were a number of differences between the measurements and technical analyses submitted by Sirius XM and the WCS Coalition in their comments. These include the power levels, duty factor or duty cycle of the WCS signal, WCS signal strength as a result of propagation losses, WCS antenna heights and positions (outside and inside the test vehicle), various combinations of WCS frequency blocks and SDARS receivers, and the use of actual WCS equipment or WiMax signal generators and other test equipment.

63. Based on our thorough review of the record in this proceeding, the individual measurements and technical analyses provided by the commenters, and the results of Sirius XM's and the

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system capacity, reducing latency, and improving spectral efficiency and cell-edge performance. *See* Agilent Technologies LTE Overview, available at <http://www.home.agilent.com/agilent/editorial.jsp?cc=US&lc=eng&cke=y=1803101&nid=34867.0.00&id=1803101>.

¹⁷⁰ *See* Comments of Ericsson, filed April 22, 2010, at 4-5.

¹⁷¹ *See* Alcatel-Lucent *Ex Parte* presentation, filed May 13, 2010, at 4.

¹⁷² *Id.*

¹⁷³ *Id.* at 5.

¹⁷⁴ *See* WCS Coalition *Ex Parte* presentation, filed May 12, 2010, at 2.

WCS Coalition's testing in Ashburn, we conclude that the public interest will be served by significantly lowering the current 20-W EIRP limit for mobile device operations in the WCS band.¹⁷⁵ Specifically, we are adopting a power limit of 250-mW average EIRP over 5 megahertz (*i.e.*, 50 mW/MHz) for mobile and portable devices operating in WCS Blocks A, B and the 2315-2317.5 and 2347.5-2350 MHz portions of WCS Blocks C and D, respectively. These power levels, coupled with the other actions that we take today, will protect satellite radio receivers from experiencing harmful interference while advancing our goal of enabling mobile broadband service to the public in the WCS spectrum, while limiting potential harmful interference to satellite radio reception. We also believe that our decision strikes the appropriate balance between the WCS Coalition's request that we adopt a 250-mW average EIRP limit for mobile and portable stations in WCS Blocks A and B¹⁷⁶ and a 150-mW average EIRP limit for mobile and portable devices in the first 3 megahertz of WCS Blocks C and D, respectively (*i.e.*, 50 mW/MHz),¹⁷⁷ and the SDARS licensees' preference for a 150 mW (50 mW/MHz) power limit on WCS mobile and portable devices operating in the 2.5-megahertz portions WCS Blocks C and D furthest removed from the SDARS band.¹⁷⁸ Overall, we find that the risk of harmful interference from WCS mobile and portable devices operating in accordance with these power limits that would seriously degrade, obstruct, or repeatedly interrupt SDARS service is low. To further reduce the risk of harmful interference, we restrict WCS mobile and portable devices from operating in the 2.5-megahertz portions of WCS Blocks C and D closest to the SDARS band, limit WCS mobile and portable devices' duty cycle, and adopt a requirement that WCS licensees expeditiously resolve any harmful interference caused to SDARS operations, should it occur.

64. Although we rely heavily on the technical information provided by the commenters, we have the benefit of Commission staff's observations of Sirius XM's and the WCS Coalition's Ashburn test results¹⁷⁹ to raise our confidence that our decisions on final rules for mobile WCS operations will reduce the risk of harmful interference to SDARS to a negligible level. During the WCS Coalition's tests of overload interference, muting of the SDARS signal only occurred during one test case. Specifically, muting occurred when the WCS device was operating with an average EIRP of 250 mW for a 5-megahertz-wide signal spanning 2.5 megahertz each of the WCS D and A blocks (*i.e.*, the edge of the WCS signal was separated by 2.5 megahertz from the edge of the SDARS band), a duty cycle of 35 percent, and when located within 1 vehicle's distance from the vehicle containing the SDARS receiver using a rooftop mounted antenna (*i.e.*, separated by at least 3 meters). Under this scenario, the WCS mobile device was uploading a large file. Muting was not observed when the WCS mobile was transmitting in the upper WCS A block. Thus, we believe that there will not be significant potential for harmful interference to SDARS receivers from WCS mobile transmitters operating at the power limits we adopt.

65. During the WCS Coalition's test, FCC staff observed that operation of a WCS mobile device at 250-mW average EIRP over 5 megahertz and a duty cycle of 35 percent in combination with a frequency separation of 2.5 megahertz from the SDARS band sufficiently mitigated the impact of overload interference to the SDARS receiver. Generally, the WCS Coalition's tests revealed what one may anticipate seeing, where additional signal attenuation was present due to the WCS device being used inside a vehicle and either held in a user's hand or on a lap, and where effects such as the difference in height between the WCS transmitter antenna and SDARS receiver antenna, the vehicle attenuation, the

¹⁷⁵ 47 C.F.R. § 27.50(a)(2).

¹⁷⁶ See, *e.g.*, WCS Coalition Oct. 7, 2009, *Ex Parte* at 3.

¹⁷⁷ See WCS Coalition Mar. 15, 2010, *Ex Parte* Letter at 2.

¹⁷⁸ See Comments of Sirius XM, filed Apr. 23, 2010, at 31.

¹⁷⁹ See paras. 55-58, *supra*.

effect of head and body losses, multipath, and clutter from other nearby objects would all come into play and have a mitigating effect on potential overload interference.

66. Also, although the Ashburn testing was not representative of a fully-deployed WCS WiMAX network, we believe the WCS device's interactions with the SDARS receivers demonstrate that the potential for harmful interference is negligible even during the worst-case situations where a WCS mobile transmitter is operating at full power without ATPC, is transmitting during the allocated transmit sub-frame of each and every frame, and is in close proximity to an OEM or aftermarket SDARS receiver. In a fully-deployed WCS network where multiple WCS mobile or portable devices are operating in close proximity to one another, these devices share the available transmit sub-carriers in a particular channel's frame, and the base station will assign each device a specific portion of the available transmit sub-carriers.¹⁸⁰ In this manner, the potential for interference from multiple proximate WCS mobile and or portable devices using their assigned portions of transmit sub-carriers will not be any greater than the potential for interference from one device using all the allocated transmit sub-carriers of each and every frame in a channel, as was demonstrated during the testing in Ashburn. In addition, not all of the WCS devices using sub-channels of the same channel will be in close proximity to an SDARS receiver, which would further lessen the potential for harmful interference to SDARS receivers. Furthermore, in a fully-deployed WCS network where more base stations are deployed to provide improved coverage and service to WCS users, WCS mobile and portable devices will experience fewer "edge-of-coverage" situations where they must operate at maximum transmitter power; instead, they will be handed off to a different base station before needing to operate at full power, thereby further reducing the potential for harmful interference to SDARS receivers.

67. In support of the 250-mW power limit, as set forth above, our examination of the record in this proceeding reflects that the potential for harmful interference to SDARS receivers from WCS mobile transmitters operating at full power in close proximity is low. Despite Sirius XM arguments to the contrary,¹⁸¹ we do not believe that the test scenario employed by Sirius XM during its testing in Ashburn, in which it used a signal generator to produce a 5-megahertz-wide WiMAX carrier in the WCS D block, immediately adjacent to the SDARS band edge, that was characterized by bursty signals,¹⁸² accurately reflects how a practical WCS two-way broadband system would operate in the 2.3 GHz band. To the contrary, as noted by the WCS licensee Horizon Wi-Com, a typical 5-ms TDD frame consists of base station transmissions, guard time, mobile station transmissions, and guard time, not simply bursty transmissions from a single mobile device that occupies every subcarrier of each 5-ms frame in a 5-megahertz-wide channel.¹⁸³ Moreover, with regard to the video that Sirius XM submitted with its May 6, 2010, *ex parte*, without knowing the test setup and technical parameters, the purported demonstration has no probative value. Also, because the radio frequency filter necessary to meet the WCS Coalition's proposed OOB limits would be too large for a mobile or portable WCS device if operated in the manner assumed by Sirius XM, we do not expect a WCS device to operate in the WCS C or D blocks in that manner once a WCS system is deployed. However, we note that when Sirius XM

¹⁸⁰ See "Understanding OFDMA, the interface for 4G wireless," Arnon Friedmann, Texas Instruments, Network Systems Design Line, April 23, 2007, at 2-3; Agilent Technologies' N1911A/N1912A P-Series Power Meters for WiMAX™ Signal Measurements Demo Guide, at 4-5.

¹⁸¹ Sirius XM argues that there is no record evidence that justifies the technical limits identified in the Commission staff's April 2, 2010 *WCS/SDARS Technical Rules Public Notice*. It asserts that WCS interests have yet to provide extensive and verifiable test data to demonstrate that mobile WCS operations will not cause harmful interference, whereas Sirius XM has demonstrated that the proposed rules will cause harmful interference. See Comments of Sirius XM, filed April 23, 2010, at 46-47.

¹⁸² A bursty signal is a method of transmission that combines a very high data signaling rate with very short transmission times. See Newton's Telecom Dictionary, 21st Edition, CMP Books, 2005, at 137.

¹⁸³ See Horizon Wi-Com May 12, 2010, *Ex Parte* Letter at 2-3.

moved its test WCS signal 2 megahertz away from the SDARS band edge, only slight muting of the SDARS signal occurred, which is consistent with the WCS Coalition's test results that resulted in only one instance of muting when the edge of the WCS signal was separated from the SDARS band edge by 2.5 megahertz. Thus, in order to further limit the potential for harmful interference to SDARS receivers, we are prohibiting WCS mobile and portable devices from operating in the 2.5-megahertz portions of WCS Blocks C and D closest to the SDARS band.

68. In establishing the allowable power level for WCS mobile and portable devices, along with the need to limit the potential for harmful interference to SDARS receivers, we also consider the impact of the mobile and portable devices' power limit on the viability of deployment of mobile service in the WCS band. We observe that mobile handheld devices operating in other services typically employ a transmitter power level of up to about 250 mW. We also observe that the trend among commercial radio services is towards the convergence of fixed and mobile services where the same network can serve the needs of consumers and businesses for both types of services and synergies are created between fixed and mobile applications. Accordingly, we believe that an average EIRP of 250 mW over 5 megahertz is an appropriate permissible power level for WCS mobile and portable devices in the WCS A and B blocks and the 2.5-megahertz portion of the WCS C and D blocks furthest removed from the SDARS band, which, with the duty cycle limits we are adopting, we believe will be sufficient to protect SDARS receivers from harmful interference while supporting the provision of WCS mobile services. For the portions of the WCS C and D blocks immediately adjacent to the SDARS band (*i.e.*, 2317.5-2320 and 2345-2347.5 MHz), however, WCS mobile and portable devices are not permitted to operate. Also, WCS mobile and portable devices using FDD technology are restricted to transmitting in the 2305-2317.5 MHz band.

69. We reject the 125-mW power limit suggested by Sirius XM for WCS mobile and portable devices because it is not necessary to protect SDARS receivers from harmful interference and because such limits could unnecessarily impede the provision of WCS mobile broadband services by forcing WCS licensees to install many more base stations than would be needed with a higher power limit for mobile and portable devices. We also reject the staggered power limits suggested by the WCS Coalition for the WCS C and D blocks. Instead, we adopt a uniform power limit for the 2.5-megahertz portions of the WCS C and D blocks that are furthest removed from the SDARS band, and prohibit mobile and portable devices from operating in the 2.5-megahertz portions of WCS Blocks C and D closest to the SDARS band. The 250-mW power limit and the 50 mW/MHz power spectral density limits we adopt will create a uniform operating environment for WCS licensees to provide mobile broadband services and, combined with the prohibition on mobile and portable devices operating in the 2.5-megahertz portions of the WCS C and D blocks closest to the SDARS band, will further limit the potential for harmful interference to SDARS receivers.

70. In order to protect SDARS operations from harmful interference, it is also necessary that we adopt a specific duty cycle that WCS devices must employ for TDD networks.¹⁸⁴ Features such as Discontinuous Transmission (DTX) and Discontinuous Reception (DRX), which are used to improve battery life and minimize intra-system interference, can substantially contribute to the reduction of a communications system's in-band and out-of-band power, and thereby significantly reduce its potential to

¹⁸⁴ In this case, we define duty cycle (also known as duty factor) as the percentage of a transmission frame that a WCS user device uses to transmit uplink information to the base station (*i.e.*, the "on time" of a WCS user device's transmitter in a given transmission frame). The activity factor is the portion of WiMAX transmission frames that the base station has allocated for uplink traffic. See Sirius XM *Ex Parte* presentation, dated February 24, 2010, at 4. See also "activity factor" and "duty cycle" definitions at Federal Standard 1037C Telecommunications: Glossary of Telecommunication Terms at <http://www.its.bldrdoc.gov/fs-1037/fs-1037c.htm>. The WCS transmitter the WCS Coalition used in its testing in Ashburn, VA, employed a duty cycle of 35 percent. See WCS Coalition *Ex Parte* filing, dated January 29, 2010, at 4.

cause harmful interference. During DTX and DRX, the number of sub-frames being exchanged on the physical layer could be reduced or the user's equipment could simply stay in the monitoring mode. Because the duty cycle is relevant to particular air interface technologies such as WiMAX and LTE, and cannot always be assured when licensees have the flexibility to select the technology of their choice, we decide to adopt a rule limiting the maximum transmitter duty cycle of mobile and portable WCS devices using TDD technology to 38 percent in the upper and lower WCS A and B blocks and the outer 2.5-megahertz portions of WCS blocks C and D (*i.e.*, 2315-2317.5 and 2347.5-2350 MHz).¹⁸⁵

71. The WCS Coalition also submits that it is common for commercial WiMAX systems to allocate approximately 38 percent of each frame to uplink (*i.e.*, user device) transmissions in order to maximize throughput based on known user traffic patterns and customer experience expectations.¹⁸⁶ It explains that, only a limited number of duty cycles are supported by the vendor community and that there is no support for the recommended 12.5-percent duty cycle. Thus, the entire C and D blocks will not be available for mobile use if the staff's proposal is adopted. And, the WCS Coalition continues, because there is no support for the 35-percent duty cycle, operators would be required to limit mobile operations to the 24.96-percent duty cycle that is the closest available, which does not violate the 35-percent limit.¹⁸⁷ Ericsson, too, explains that there are a variety of TD-LTE uplink-downlink configurations that allow a network operator to allocate the network's capacity between uplink and downlink traffic to meet the needs of the network. Although an examination of the uplink/downlink duty cycles of seven configurations shows that three of the seven uplink/downlink configurations for TD-LTE set forth in the global standard exceed the proposed uplink duty cycle limit of 38 percent (which are relatively symmetrical configurations), the remaining configurations are highly asymmetrical in favor of downlink traffic, with uplink duty cycles ranging from approximately 11.7 to 31.7 percent. Notably, the 38-percent duty cycle exceeds the majority of the profiles in commercially available WiMAX systems.¹⁸⁸ A network that can match the uplink-downlink needs of users will use spectrum more efficiently, Ericsson contends, and if a large proportion of a network's traffic is uplinked such as video, a limitation of the uplink duty cycle will cause uplink data sessions to be more congested and slower.¹⁸⁹

72. We find that application of a 38-percent duty cycle to WCS mobile and portable operations will not appreciably increase the potential for harmful interference to SDARS receivers even though the 38-percent duty cycle limit is slightly higher than the 35-percent duty cycle demonstrated in Ashburn, VA. Although a maximum duty cycle limit has been shown to be an important factor in limiting a WCS mobile or portable device's potential to interfere with SDARS receivers, we believe the most critical factors in controlling the potential for harmful interference in this case are the relative power of a WCS signal and the spectral proximity of the WCS signal to the SDARS band. Thus, in our judgment, a 38-percent duty cycle limit coupled with the 250-mW EIRP over 5-megahertz mobile/portable device power limit, the 2.5-megahertz WCS guard bands, and the requirement to employ

¹⁸⁵ In support of this duty cycle limit, we note that in order for a 2.6 GHz WiMAX CPE device to obtain a 1 megabit per second (Mbit/sec) uplink data rate with a 5-megahertz-wide Orthogonal Frequency Division Multiple Access 512 Fast Fourier Transform 64 Quadrature Amplitude Modulation (OFDMA 512 FFT 64 QAM) output signal (*i.e.*, 512 subcarriers), the typical duty cycle setting for the device is 37.4 percent. *See* Motorola, Inc.'s United States Patent Application 20090295485, Dynamically Biasing Class AB Power Amplifiers Over a Range of Output Power Levels, *available at* <http://www.freepatentsonline.com/y2009/0295485.html>, at 6.

¹⁸⁶ *See* WCS Coalition *Ex Parte* filing dated March 31, 2010, at 2. The WCS Coalition test transmitter used in the Ashburn, VA testing employed a duty cycle of 35 percent, and only caused the SDARS signal to mute in one isolated instance. *See* WCS Coalition *Ex Parte* filing, dated Jan 29, 2010, at 4.

¹⁸⁷ *See* WCS Coalition March 31, 2010 *Ex Parte*, at 3, and Attachment at 2.

¹⁸⁸ *See* Comments of Ericsson Inc. filed April 22, 2010, at 3.

¹⁸⁹ *Id.*, at 4.

ATPC that we are adopting, will be sufficient to limit the potential for harmful interference to SDARS receivers. We also believe that application of a 38-percent duty cycle to WCS mobile and portable operations will allow for the majority of TDD WiMax and Long Term Evolution (LTE) profiles to be implemented. Notwithstanding that this limit is applicable to, and was determined when testing WiMAX equipment, we believe it is appropriate to apply it to other TDD technology, such as LTE. Granting that some high data rate uplink applications such as video uploads would run more efficiently in a more symmetrical configuration (*i.e.*, with a higher uplink duty cycle), we find that application of a maximum duty cycle setting of 38 percent strikes an appropriate balance between our goals of protecting SDARS receivers from harmful interference and enabling the provision of WCS mobile broadband services using different technologies.

73. We decline to adopt a frame repetition limitation as proposed by Sirius XM, whereby a WCS mobile device would be limited to transmitting on every other 5-ms TDD transmit frame.¹⁹⁰ Rather, we require WCS licensees to apply the duty cycle requirement in a manner that is referenced directly to the frame duration for the technology in use in order to strike an appropriate balance between our goals of protecting SDARS receivers from harmful interference and enabling the provision of WCS mobile broadband services using different technologies.

74. We also permit WCS mobile and portable transmitting devices using FDD technology in the 2305-2317.5 MHz band (and consequently FDD base station transmitters in the upper WCS blocks). We restrict mobile transmitters to the lower WCS block to accommodate XM's earlier proposal to limit the upper WCS bands to base stations only, which, as they contend, would reduce the likelihood of interference to legacy XM receivers.¹⁹¹ Restricting mobile transmitters to the lower WCS blocks would also improve adjacent-band sharing with AMT and would accommodate the Aerospace and Flight Test Radio Coordinating Council's (AFTRCC's)¹⁹² proposal to limit the use of the upper WCS bands to base stations only.¹⁹³ For WCS mobile and portable devices operating in the 2305-2317.5 MHz band using FDD technology, we set the same transmitter power level of 250-mW average EIRP with ATPC. In order to further limit the potential for interference to SDARS receivers from WCS operations, WCS mobile and portable devices using FDD technology are restricted to transmitting in the lower WCS A and B blocks and the 2.5-megahertz portion of the WCS C block furthest removed from the SDARS band (*i.e.*, 2305-2317.5 MHz). Recognizing that neither the WCS nor SDARS licensees provided analysis or testing of FDD equipment, we rely heavily on the fact that mobile and portable device using FDD technology will have a dedicated band for uplink transmissions rather than sharing a band with base stations' downlink transmissions to establish this restriction. We also limit the duty cycle of WCS mobile and portable devices using FDD technology to a duty cycle of 25 percent for the lower WCS A and B blocks (*i.e.*, 2305-2315 MHz) and maintain the 12.5-percent duty cycle for the 2.5 megahertz portion of the WCS C block furthest from the SDARS band (*i.e.*, 2315-2317.5 MHz). To treat the paired A and B block licenses equitably, we adopt a duty cycle limit that is double the limit currently specified in our Rules for WCS portable devices operating in the 2305-2315 MHz band.¹⁹⁴ We note that Sirius XM did not object to the graduated duty cycle levels proposed by the Commission staff which included a 12.5-percent duty

¹⁹⁰ See Sirius XM *Ex Parte*, filed May 13, 2010, at 9-10.

¹⁹¹ See XM Reply Comments, filed March 17, 2008, at 33-36; Sirius XM Aug. 11, 2009 *Ex Parte* presentation at 27. See also Sirius XM Jan. 22, 2010, *Ex Parte* presentation at 12.

¹⁹² AFTRCC, founded in 1954, is a not-for-profit organization of Radio Frequency Management Representatives from major aerospace companies and is the Non-Federal Government coordinator for the shared Federal/Non-Federal spectrum allocated for flight testing. See <<http://www.aftcc.org/>> (last visited October 26, 2009).

¹⁹³ See AFTRCC March 22, 2010 *Ex Parte* presentation at 15.

¹⁹⁴ 47 C.F.R. § 27.53(a)(9)(i).

cycle limit on mobile and portable transmitters operating in the 2.5-megahertz portion of the WCS C block furthest from the SDARS band.¹⁹⁵ By restricting the duty cycle of such devices, their potential for interference to adjacent-band SDARS receivers will be limited even though these devices will be operating with a 100-percent activity factor.

75. We will continue to require that WCS devices be ATPC-capable. The use of ATPC (automatic transmit power control) by the WCS licensees will also help to mitigate the potential for SDARS receiver overload interference.¹⁹⁶ We note that ATPC has been, and will continue to be, an integral feature of various commercial mobile service technologies. ATPC use is motivated by the need to control interference within a licensee's own system and by extension neighboring bands. We expect that WCS licensees, no matter what technology they deploy, will implement ATPC to control self interference. We therefore have no reason to believe that WCS networks will be configured to use maximum power to achieve maximum data throughput at all times. This would run counter to the principles of intra-system interference control. Moreover, operating all portable devices at full power all the time would tend to sharply increase intra-cell and inter-cell interference, which would lead to capacity reduction and would reduce battery life, although we recognize that there can be trade-offs on whether it is best to transmit high data rates for short periods or lower data rates for longer periods. Consequently, use of ATPC will make it unlikely that a WCS mobile or portable station's transmitter power will be at its maximum level of 250 mW at all times, which will further mitigate the potential for harmful interference to SDARS receivers. Thus, we require that WCS mobile and portable devices include the capability for ATPC, as proposed by the WCS Coalition and as currently required by Part 27 of our Rules for WCS portable devices.¹⁹⁷

76. We also will prohibit the use of vehicle roof-mounted antennas for WCS transmissions and reception. The WCS Coalition's Ashburn tests were performed with the WCS device in the vehicle. Because of this, the WCS signal was attenuated by the glass windows and metal and composite structure of the vehicle. If a WCS device was installed inside a vehicle but the device's antenna was mounted on the outside of the vehicle, however, this attenuation would not exist, and we would expect more SDARS receiver muting to occur. Although we have not seen any evidence that such outside antenna installations would be the predominant use of mobile WCS networks, in order to forestall the potential for interference from such situations, we are adopting a rule to prohibit the use of vehicle roof-mounted antennas for WCS transmissions and reception.

77. We believe that the 250-mW average EIRP limit over 5 megahertz we are establishing for mobile and portable devices in the WCS Blocks A and B and the 2.5-megahertz portions of WCS Blocks C and D furthest removed from the SDARS band, coupled with a duty cycle limit of 38 percent and the prohibition of WCS mobile and portable devices operating in the 2.5-megahertz portions of the WCS C and D blocks closest to the SDARS band, are sufficient to protect existing SDARS receivers from harmful interference and at the same time provide as much flexibility as possible to WCS licensees to provide mobile services. Nonetheless, we expect the two services to work together cooperatively and take whatever additional steps are necessary to mitigate potential harmful interference and expeditiously remedy harmful interference, should it occur.

¹⁹⁵ See Comments of Sirius XM Radio Inc. filed April 23, 2010, at 30. In support of setting the duty cycle at 12.5 and 25 percent, respectively, we recognize that mobile and portable FDD devices' transmitters typically employ a 100-percent activity factor (*i.e.*, FDD-based networks employ a dedicated band for uplink transmissions and there is no sharing of a band for uplink transmissions and downlink transmissions, as in a TDD network).

¹⁹⁶ See n.5, *supra*.

¹⁹⁷ 47 C.F.R. § 27.53(a)(9)(iv).

78. We believe that the rules we adopt are sufficient to mitigate the risk of harmful interference to SDARS to a negligible level. WCS licensees, however, are obligated to expeditiously remedy harmful interference caused to SDARS. Harmful interference is that which seriously degrades, obstructs or repeatedly interrupts SDARS reception (i.e. muting). We establish, below, a notification process whereby WCS licensees and SDARS licensees are required to share sufficient information prior to operation to provide an opportunity for licensees to analyze the placement of infrastructure, assess the potential for harmful interference, and allow for modifications to mitigate interference risk prior to operation. The notification process will also assist the licensees in identifying the cause of actual harmful interference and lead to a timely resolution of such interference.

79. *Prior notification of WCS information.* We require prior notification to minimize the potential for harmful interference between WCS and SDARS. Specifically, we require WCS and SDARS licensees to share information regarding the location and technical parameters of their base stations and terrestrial repeaters, respectively. WCS licensees must notify the SDARS licensee of the location of any new or modified base stations that will operate in the 2305-2320 MHz and 2345-2360 MHz bands prior to operation. Furthermore, WCS licensees must cooperate in good faith in the selection and use of new station sites and new frequencies to minimize the potential for harmful interference and make the most effective use of the authorized facilities. Notwithstanding the relatively short notification times we establish below, we expect WCS licensees to provide Sirius XM as much lead time as practicable, under non-disclosure agreements if appropriate, to provide ample time to conduct analyses and opportunity for prudent base station site selection prior to WCS licensees entering into real estate and tower leasing or purchasing agreements.

80. *Pre-Commercial Service Operation.* We anticipate that any interference problems will become evident during the initial deployments and market trials of WCS mobile service. During the time when market trials begin but full commercial service has not yet been initiated, the licensees will have an opportunity to conduct further tests using actual WCS equipment in particular markets. We expect any interference issues that arise during market trials to be resolved before the transition from market trials to commercial service happens. We also expect that WCS licensees will have sufficient operational flexibility in their network design to implement one or more technical solutions to remedy harmful interference before it occurs in a fully loaded network offering commercial service. The notification process will foster early collaboration at the network planning and deployment stages so licensees can gain experience with the WCS network operations and gain confidence that harmful interference will not occur. That experience could be valuable in streamlining the process further in other similarly situated markets.

81. *Post Operation.* Licensees of stations suffering or causing harmful interference must cooperate in good faith to expeditiously resolve such problems by mutually satisfactory arrangements. If the licensees are unable to do so, either licensee may file an interference complaint with the Commission. The Wireless Telecommunications Bureau, in consultation with the Office of Engineering and Technology and the International Bureau, will consider the actions taken by the parties to mitigate the risk of and remedy any alleged interference. In determining the appropriate action, the Bureau is to take into account the nature and extent of the interference and act promptly to remedy the interference. The Bureau may impose restrictions including specifying the transmitter power, antenna height, or other technical or operational measures to remedy the interference, and take into account previous measures by the licensees to mitigate the risk of interference. WCS operators will have at their disposal various techniques (e.g., power reduction, duty cycle, etc.) that would not require specific end-user device modifications. WCS licensees must use these network control capabilities to expeditiously remedy interference once notified.

82. In this connection, we recognize there are legacy SDARS receivers deployed in large numbers, and that some of those receivers are more susceptible to interference than others. We note Sirius XM's assertion that the SDARS receivers were designed based on the existing FCC rules, which effectively precluded mobile WCS operations. We observe that the rules we adopt today will now

provide for the deployment of wide area mobile networks and lead to the possibility of mobile devices being in close proximity to SDARS receivers, albeit at much less power than 20 W. At the same time, we are cognizant of the need to consider the potential impacts of our decision on existing SDARS receivers and the resultant impacts on consumers, irrespective of Sirius XM's assumptions as to the nature of the operations in the adjacent WCS spectrum. On a going forward basis, however, Sirius XM will be able to take into account the mobile WCS operating environment when designing new receivers, and we anticipate that future deployments of SDARS receivers will be built consistently robust to interference from mobile WCS operations.¹⁹⁸ We believe that the introduction of a new class of interoperable SDARS receivers presents an opportunity to also ensure that future SDARS receivers continue to exhibit state-of-the-art filtering sufficiently adequate to accommodate the RF environment established by the rules we adopt today for future adjacent-band WCS mobile stations' operations. Although we conclude based on our analysis of the extensive technical record and the results of the testing in Ashburn, VA that the WCS mobile and portable devices' limits we adopt herein will adequately protect legacy SDARS receivers from harmful interference, we expect Sirius XM to adjust to the changed RF environment in the 2.3 GHz band so that over time, the potential for interference to SDARS receivers will diminish even further as these receivers' susceptibility to interference decreases.

D. WCS Mobile and Portable Device Out-of-Band Emissions Limits

83. Our principal objectives in this proceeding are to mitigate the potential for harmful interference that may be caused to adjacent-band services while at the same time enabling the provision of promising new mobile broadband services to the public in the WCS spectrum to the maximum extent practicable. For the reasons stated below, we adopt a revised OOB attenuation factor to protect satellite radio users, NASA Deep Space Network receivers, and AMT receivers. Specifically, we relax the $110 + 10 \log(P)$ dB OOB attenuation factor that currently applies to WCS mobile devices operating in the WCS A and B blocks and the 2.5-megahertz portion of the WCS C and D blocks furthest removed from the SDARS band (2305-2317.5 MHz and 2347.5-2360 MHz)¹⁹⁹ to the following factors: not less than $55 + 10 \log(P)$ dB in the 2320-2324/2341-2345 MHz bands, not less than $61 + 10 \log(P)$ dB in the 2324-2328/2337-2341 MHz bands, and not less than $67 + 10 \log(P)$ dB in the 2328-2337 MHz band to protect SDARS. Additionally, to protect the National Aeronautics and Space Administration (NASA) Deep Space Network below the WCS band, mobile and portable stations' OOB must be attenuated by a factor of not less than $43 + 10 \log(P)$ dB in the 2300-2305 MHz band, not less than $55 + 10 \log(P)$ dB in the 2296-2300 MHz band, not less than $61 + 10 \log(P)$ dB in the 2292-2296 MHz band, not less than $67 + 10 \log(P)$ dB in the 2288-2292 MHz band, and not less than $70 + 10 \log(P)$ dB below 2288 MHz. To protect AMT operations above the WCS band, mobile and portable stations' OOB must also be attenuated by a factor of not less than $43 + 10 \log(P)$ dB in the 2360-2365 MHz band, and not less than $70 + 10 \log(P)$ dB above 2365 MHz. We revise the $110 + 10 \log(P)$ dB OOB attenuation in Section 27.53(a)(2) accordingly, and remove Section 27.53(a)(9), which provides that portable devices in the 2305-2315 MHz band may operate subject to an OOB attenuation of $93 + 10 \log(P)$ dB into the SDARS band, provided that they meet certain technical requirements.

84. In the *2007 Notice*, we sought comment on the costs and benefits of revising the OOB limits that currently apply to SDARS and WCS.²⁰⁰ We specifically asked interested parties to comment

¹⁹⁸ See *Fostering Innovation and Investment in the Wireless Communications Market*, GN Docket No. 09-157; *A National Broadband Plan For Our Future*, GN Docket No. 09-51, *Notice of Inquiry*, 24 FCC Rcd 11322, 11333 ¶ 36 (2009), where the Commission noted how receivers' lack of rejection of adjacent-band signals could impede or prevent effective operation of new services in the adjacent band or necessitate the imposition of limits on the types of operations permitted in the adjacent band.

¹⁹⁹ See 47 C.F.R. § 27.50(a)(1).

²⁰⁰ *2007 Notice*, 22 FCC Rcd at 22142 ¶ 24.

on the impacts (including interference, economic, and business) that any revision of the OOB limits would have on SDARS operations.²⁰¹ We also requested parties to address how the WCS industry would be affected if we were to retain the current OOB limits.²⁰²

85. WCS licensees and other parties argue in the first instance that unless the OOB limits for mobile and portable devices in the 2305-2320 and 2345-2360 MHz WCS bands are relaxed they will be unable to develop affordable equipment capable of providing mobile broadband services to consumers.²⁰³ The WCS Coalition states that it seeks relief only for subscriber equipment operating at lower power levels, including mobile stations transmitting at less than 2 W average EIRP.²⁰⁴ The WCS Coalition further claims that the current $110 + 10 \log(P)$ dB mask exceeds what is required to protect an SDARS receiver by a margin of 50 dB.²⁰⁵ Accordingly, the WCS Coalition proposes that we adopt the following OOB attenuation factors for WCS mobile and portable devices: $55 + 10 \log(P)$ dB in the 2320-2324/2341-2345 MHz bands, $61 + 10 \log(P)$ dB in the 2324-2328/2337-2341 MHz bands, and $67 + 10 \log(P)$ dB in the 2328-2337 MHz band.²⁰⁶ The WCS Coalition bases its proposed OOB attenuation factors of $55/61/67 + 10 \log(P)$ dB on their feasibility and the potential economic viability they offer over the existing $110 + 10 \log(P)$ dB mask currently required for WCS mobile devices in Section 27.53(a).²⁰⁷ The emission mask proposed by the WCS Coalition would also require that all devices use ATPC.²⁰⁸ The WCS Coalition, however, concedes that its proposal does not entirely foreclose the possibility of potential interference from WCS to SDARS subscribers.²⁰⁹

86. On the other hand, Sirius and XM initially proposed that we relax the OOB attenuation factors for WCS mobile and portable devices from $110 + 10 \log(P)$ dB to $103 + 10 \log(P)$ dB for all WCS spectrum blocks.²¹⁰ Sirius asserts that the WCS Coalition's proposal to reduce the OOB

²⁰¹ *Id.*, at 22142-3 ¶ 25.

²⁰² *Id.*

²⁰³ See WCS Coalition Comments at 4-5; Motorola Comments at 8-9. See also Bednekoff Comments at 1-2; WCS Coalition Reply Comments at 7-9.

²⁰⁴ WCS Coalition Comments at 10.

²⁰⁵ *Id.* at 14. The WCS Coalition contends that an OOB attenuation of $55 + 10 \log(P)$ dB will sufficiently protect SDARS receivers in such a way that the receiver's noise floor does not rise by more than 1 dB for 94 percent of the time. See WCS Coalition Comments at 11, 13, and Attachment B at 25. The WCS Coalition notes that the 1-dB figure it uses is a typical industry value for noise floor protection. In addition, the WCS Coalition estimates the noise floor of SDARS receivers to be -106.8 dBm/4MHz, or -112.8 dBm/MHz. See also WCS Coalition Reply Comments, Attachment A. WCS calculates its noise floor using a thermal noise power of -108 dBm/4 MHz (based on an antenna temperature of 290° K), or -114 dBm/MHz, and a receiver noise figure of 1.2 dB. We note that these parameters, when used in a common formula for calculating the noise floor for a terrestrial receiver, produce the noise floor calculated by the WCS Coalition.

²⁰⁶ See WCS Coalition Comments at 10. Henceforth, we refer to this OOB mask as the $55/61/67 + 10 \log(P)$ dB mask.

²⁰⁷ See 47 C.F.R. §§ 27.53(a). WCS Coalition Comments at 4-7.

²⁰⁸ *Id.* at 14. See n.5, *supra*, for a description of ATPC.

²⁰⁹ WCS Coalition Comments at 3 and 11. NextWave Wireless indicates that, alternatively, a "flat mask" of $60 + 10 \log(P)$ dB, which is roughly equivalent to the WCS Coalition's stepped mask proposal, would serve to provide adequate protection to SDARS. See also NextWave Wireless Nov. 16, 2008, *Ex Parte* at 2.

²¹⁰ See Sirius Comments at 34; XM Comments at 32, Exhibit A at 18 (proposing an OOB attenuation factor of $102.7 + 10 \log(P)$ dB). Sirius XM later adds that, based on its tests, satellite radio devices could experience frequent muting under foliage or near reflective buildings if the OOB attenuation factors were established between $97 + 10 \log(P)$ dB and $92 + 10 \log(P)$ dB, and complete muting if the OOB attenuation factor was below

(continued...)

attenuation factor for WCS mobile devices to $55 + 10 \log (P)$ dB would result in unacceptable mobile-to-mobile interference, even if separated by a large distance from an SDARS receiver.²¹¹ XM claims that, under the limits proposed by the WCS Coalition, a hypothetical mobile WiMAX device operating in the WCS band could cause interference to satellite radio reception within a radius of 115 meters around the WCS device.²¹²

87. Based on the same SDARS radio parameters in its previous filings²¹³ and its contention that a maximum receive interference power of -107 dBm/4MHz would produce muting of the SDARS satellite receiver, Sirius XM later adjusted its proposed WCS OOB attenuation factor to $86.5 + 10 \log (P)$ dB.²¹⁴ In its *ex parte* filing, Sirius XM added its calculated path loss of 56.7 dB to the -107 dBm/4 MHz maximum interference power to obtain a maximum WCS mobile device OOB level of -50.3 dBm/4MHz (-56.3 dBm/MHz).²¹⁵ Sirius XM explains that this level is equivalent to an emission attenuation factor of $86.3 + 10 \log (P)$ dB, which Sirius XM rounded to $86.5 + 10 \log (P)$ dB.²¹⁶

88. *Measurements and Technical Analyses.* The parties' arguments relative to the WCS OOB limits are interwoven with their arguments relative to WCS signal attenuation and the SDARS receiver parameters. In particular, path loss is central to their arguments about potential interference and the interference criteria to use to determine the potential for harmful interference due to WCS OOB has been debated heavily. The WCS Coalition and Sirius XM conducted several individual measurements, tested various SDARS receivers, and provided numerous technical analyses in their comments in an effort to support their proposals. We describe these below.

(Continued from previous page) _____

$92 + 10 \log (P)$ dB. See also Sirius XM Sept. 8, 2008, *Ex Parte* at 13-15 and subsequent corrections to this filing made on September 10, 2008, ("Sirius XM Sept. 10, 2008, *Ex Parte*") and Sept. 18, 2008, ("Sirius XM Sept. 18, 2008, *Ex Parte*").

²¹¹ Sirius Comments at 20-21.

²¹² XM Comments at 32.

²¹³ Sirius XM Nov. 13, 2008, *Ex Parte*, Appendix at 6. These assumptions include a received interfering power of -119 dBm/4MHz, or -125 dBm/MHz, causing a 1-dB rise in the noise floor of -113 dBm/4MHz, or -119 dBm/MHz; a received interfering power of -107 dBm/4 MHz, causing muting of the SDARS satellite radio, given an average serving signal level of -100 dBm/4 MHz; a carrier-to-interference-plus-noise (C/(I+N)) ratio of 6 dB required for decoding the receive signal; a combined interference plus noise (I+N) level causing muting of the serving signal, -100 dBm/4 MHz – 6 dB, or -106 dBm/4 MHz, which, when considered with the -113 dBm/4MHz noise floor, necessitates the maximum -107 dBm/MHz receive interference power cited above to avert muting of the SDARS receiver. See also Sirius XM Sept. 8, 2008, *Ex Parte*, Exhibit B.

²¹⁴ Sirius XM applies a methodology consistent with that used by the Commission's Office of Engineering and Technology in its technical report on Advanced Wireless Services (AWS) interference, while maintaining the same assumptions that underlie its previous recommendations. See Sirius XM Nov. 13, 2008, *Ex Parte* at 1, 4, Appendix at 8 and 10. See also Advanced Wireless Service Interference Tests Results and Analysis, Federal Communications Commission, Office of Engineering and Technology, WT Docket No. 07 195 (filed Oct. 10, 2008). When subtracting out 7.5 dB of losses due to head and body, antenna mismatch, and multipath/shadowing, in addition to free space loss (FSL) at 3 m (49.2 dB), Sirius XM contends to show that its receiver will experience muting if the WCS OOB attenuation level in the SDARS bands is below $94 + 10 \log (P)$ dB. See Sirius XM Nov. 13, 2008, *Ex Parte*, Appendix at 13.

²¹⁵ Sirius XM Nov. 13, 2008, *Ex Parte* at 10.

²¹⁶ Sirius XM Nov. 13, 2008, *Ex Parte* at 4.

89. In an effort to bolster its arguments for its proposed stepped OOB mask, the WCS Coalition measured the noise floor associated with practical installations of SDARS antennas²¹⁷ and determined that to avoid raising the SDARS receiver's noise floor by more than 1 dB (the interference criteria initially proposed by the SDARS licensees), the maximum WCS OOB received at the SDARS receiver must not exceed a level approximately 6 dB below the noise floor.²¹⁸ The WCS Coalition also measured the path loss from a WCS transmitter to an SDARS receiver.²¹⁹ To simulate a WCS device, the WCS Coalition used a 30-kHz continuous tone and a WiMAX signal generator together with a "chip" antenna mounted to a cart with an elevated antenna on a plastic pole at the same height as the SDARS test receive antenna.²²⁰ The SDARS test receive antenna was mounted on a vehicle roof, and a spectrum analyzer was used to measure the received signal.²²¹ In its filing, the WCS Coalition displayed the results of its tests and, using curve fit analysis, concluded that they yielded an aggregate Wireless Coalition Path Loss Model (WPM) of $50.9 + 21.8 \log(D_{\text{meters}})$ dB for distances from 5 to 50 feet (1.5 to 15 meters).²²² The WCS Coalition employed this aggregate WPM in subsequent showings and presentations.²²³ Using its WPM, the WCS Coalition calculated the path loss at a separation of 3 meters to be 61.3 dB.²²⁴ In an effort to show that its minimum proposed OOB mask attenuation of $55 + 10 \log(P)$ dB at the WCS transmitter will protect SDARS receivers to 6 dB below their noise floor 94 percent of the time, the WCS Coalition used a probabilistic simulation which incorporated its WPM-based path loss, ATPC (which the simulation assumes exceeds 3 dB for 99 percent of the time), and increased OOB attenuation resulting from ATPC, owing to operation of the transmitter in its non-linear region.²²⁵

90. Taking a different approach, the WCS Coalition also measured the distance-to-mute of the SDARS receiver due to OOB produced by the complete proposed WCS OOB mask attenuation of $55/61/67 + 10 \log(P)$ dB, together with duty cycles of 6 percent for such applications as VoIP calling,

²¹⁷ The WCS Coalition measured the noise floor of SDARS antennas at -106.2 dBm/4 MHz (-112.2 dBm/MHz) in a rural area and -96.4 dBm/4 MHz (-102.4 dBm/MHz) in an urban area. *See* WCS Coalition Reply Comments, Attachment A.

²¹⁸ WCS Coalition Comments at 13, Attachment B at 11. The WCS Coalition notes that the 1-dB figure is a typical value used by industry for noise floor protection.

²¹⁹ WCS Coalition Reply Comments, Attachment B at 4 and 25. The WCS Coalition completed measurements of its WPM of $(50.9 + 21.8 \log(D_{\text{meters}}))$ dB between antenna connectors, *i.e.*, from the input of the transmit antenna to the output of the SDARS receive antenna, on unobstructed paths of varying distances. *See also* WCS Coalition Reply Comments, Attachment B at 15, 20, and 24.

²²⁰ WCS Coalition Reply Comments, Attachment B at 14, 15, 20, and 24.

²²¹ WCS Coalition Reply Comments, Attachment B at 14, 15, 20, and 24. A photograph of the test set-up suggests that the tests were conducted with the WCS transmitter located to the side of the vehicle. Similar earlier tests were conducted earlier with the WCS transmitter located to the front of the vehicle, at a 45-degree angle from the front, and to the side of the vehicle, with similar results: an attenuation factor of $52 + 22 \log(P)$ dB. *See* WCS Coalition Comments, Attachment B at 12.

²²² WCS Coalition Reply Comments, Attachment B at 4, 22, and 25. We observe that the WPM path loss can also be approximated as Free Space Loss (FSL) + 12 dB.

²²³ *See, e.g.*, WCS Coalition Aug. 1, 2008, *Ex Parte* at 2.

²²⁴ WCS Coalition Aug. 1, 2008, *Ex Parte* at 13.

²²⁵ WCS Coalition Comments, Attachment B at 16-25. The WCS Coalition notes that ATPC is considered a crucial algorithm in many cellular technologies, such as WiMAX, as it minimizes intra-system interference and maximizes battery life. The WCS Coalition also notes that it assumes a conservative 2-dB reduction in WCS OOB for every 1-dB reduction in the fundamental WCS signal, and only for the first 5 dB of reduction in the fundamental, thereafter assuming a 1-dB reduction in OOB for every 1-dB reduction in the fundamental. WCS Coalition Comments at Attachment B, 11 and 23. *See also* WCS Coalition Reply Comments at Attachment C, 5.

and 43 percent for such applications as data uploads.²²⁶ The WCS Coalition measured the muting distance to be less than 3 meters for the 6-percent duty cycle case, but approximately 6.4 to 7.3 meters for the 43-percent case.²²⁷ The WCS Coalition contends its analysis demonstrates that the extra attenuation needed to ameliorate the 43-percent duty cycle case and reduce the separation distance to 3 meters can be provided by accounting for vehicular-mobile obstructions such as tinted glass, body loss, and other vehicles; for the low probability that a WCS user will actually be transmitting in proximity to the SDARS receiver; for ATPC and increased OOB attenuation as described above; and for the highly unlikely expectation of WCS operation at 43-percent duty cycle.²²⁸

91. Sirius conducted tests on SDARS receivers and made path loss measurements as well. In developing its original proposal for an OOB attenuation factor of $103 + 10 \log(P)$ dB to protect an SDARS receiver (located in a vehicle at a minimum distance of 3 meters)²²⁹ from a WCS mobile transmitter,²³⁰ Sirius modeled the path loss from a WCS transmitter to an SDARS receiver as (Free Space Loss (FSL) + 3 dB) (SDARS Propagation Model).²³¹ Sirius determined its SDARS Propagation Model (SPM) of (FSL + 3 dB) by taking measurements between antenna connectors, *i.e.*, from the input of the transmit antenna to the output of the SDARS receive antenna, on an unobstructed path at varying distances.²³² In its model, Sirius attributes the additional 3 dB to various coupling losses.²³³ To simulate a WCS device during its testing, Sirius used a WiMAX signal generator together with a dipole antenna mounted on a cart and elevated on a pole 6 feet (approx. 2 meters) above ground, with a gain of 0 dBi toward the horizon.²³⁴ The SDARS test receiving antenna was mounted on the rear portion of a sedan roof with the receiver inside the vehicle, which Sirius explains is a typical OEM factory installation.²³⁵ In

²²⁶ WCS Coalition Reply Comments at 13, Attachments B and C. The WCS Coalition used a white noise generator at stepped power levels to simulate the WCS OOB.

²²⁷ WCS Coalition Reply Comments at 13; Attachment B at 19- 20; Attachment C at 3.

²²⁸ WCS Coalition Reply Comments, Attachment C at 4-7.

²²⁹ Sirius Comments, Exhibit A at A14. Sirius states that it believes this distance represents the absolute maximum interference radius around WCS user terminals that SDARS service can tolerate without significant service disruption. Sirius also relates this distance to the average lane widths of 3.3 meters to 4 meters for major roads, from the Bureau of Transportation Statistics. Sirius Reply Comments, Exhibit B at 5; U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Journal of Transportation and Statistics, Volume 7, Number 23, Development of Prediction Models for Motorcycle Crashes at Signalized Intersections on Urban Roads in Malaysia, Table 1 - Description, Factor Levels, Coding System, and Basic Statistics of the Explanatory Variables, Department of Transportation Statistics, available at <http://www.bts.gov/publications/journal_of_transportation_and_statistics/volume_07_number_23/html/paper_03/table_03_01.html>. We note that the mean lane width of 3.6 meters in the above reference agrees with the predominant 12-foot (3.7 meters) lane width of "federal aid" highways in the United States. See U. S. Department of Transportation, Federal Highway Administration, table at <<http://www.fhwa.dot.gov/ohim/hs98/tables/hm33.pdf>>.

²³⁰ Sirius explained that to avoid raising the receiver's noise floor by more than 1 dB, the maximum WCS OOB emissions received at the SDARS receiver must not exceed a level 5.9 dB below the noise floor, or -124.9 dBm/MHz. Sirius XM also measured the noise floor of its receiver to be -119 dBm/MHz.

²³¹ Sirius Comments, Exhibit A at A14; Exhibit C at C5-C9.

²³² *Id.*

²³³ Sirius Comments, Exhibit A at A14.

²³⁴ Sirius Comments, Exhibit C at C5; Sirius Reply Comments, Exhibit C at 4.

²³⁵ Sirius Comments, Exhibit C at C5-C6. A photograph of the test set-up suggests that the tests were conducted with the WCS transmitter located to the side of the sedan.

its filing, Sirius displayed the results of its tests and concluded that they are in agreement with its SPM of (FSL + 3 dB).²³⁶

92. At a distance of 3 meters and using its SPM, Sirius calculated a path loss of 52.2 dB. To obtain the maximum permissible power of OOB emissions at the WCS transmitter, Sirius added the 52.2-dB SPM path loss to the -124.9 dBm/MHz maximum power of OOB interference at the receiver, resulting in a maximum OOB power of -72.7 dBm/MHz at the transmitter. Sirius explained that this level is equivalent to an emission mask attenuation of $102.7 + 10 \log (P)$ dB, which it rounded to $103 + 10 \log (P)$ dB, where P is the average transmitter output power in Watts.²³⁷

93. *Ashburn, VA Tests.* In the testing in Ashburn, Virginia noted above, Sirius XM used a signal generator and other test equipment to create what it argues is a signal that is representative of the OOB levels that would result from a WiMAX transmission in the WCS bands. The WCS Coalition separately tested an actual WCS device operating with a WCS base station to produce the OOB levels that would be present in the SDARS bands.²³⁸ Both tests used OEM and aftermarket SDARS receivers in order to determine the distance at which muting of the SDARS receiver would occur due to OOB interference.²³⁹ In the paragraphs below, we discuss the WCS Coalition's and Sirius XM's interpretation of their respective test results.

94. The WCS Coalition asserts that its Ashburn tests show that the WCS Coalition's proposed OOB limits and reduced mobile power levels, coupled with other vehicular-mobile parameters that will attenuate the WCS signal, will be sufficient to protect SDARS operations from harmful interference when the WCS and SDARS users are separated by only 3 meters.²⁴⁰ In support of its position, the WCS Coalition points out that the SDARS signal experienced only slight muting even when the WCS mobile device was operating with a fixed EIRP of 250 mW (*i.e.*, without ATPC) and an OOB attenuation factor of $43 + 10 \log (P)$ dB, which was less restrictive than its proposal of $55 + 10 \log (P)$ dB in the 2320-2324 MHz and 2341-2345 MHz portions of the SDARS band. However, the WCS Coalition, in addition to its earlier power/spectral mask proposal of 250 mW/55/61/67 + 10 log (P) dB for all WCS mobile and portable devices, proposes to apply the power/spectral mask of $55 + 10 \log (P)$ dB in the first 4 megahertz of the SDARS band (*i.e.*, 2320-2324/2341-2345 MHz), $61 + 10 \log (P)$ dB in the next 4 megahertz of the SDARS band (*i.e.*, 2324-2328/2337-2341 MHz), and $67 + 10 \log (P)$ dB in the center 9 megahertz of the SDARS band (*i.e.*, 2328-2337 MHz) to the following WCS devices: (a) battery-operated (*i.e.*, mobile and portable) user stations transmitting at no greater than 250 mW average EIRP on the A and B blocks; (b) battery operated user stations transmitting at no greater than 50 mW/MHz average EIRP between the 2315-2318 and 2347-2350 MHz portions of the C and D blocks, respectively; and (c) battery operated user stations transmitting at no greater than 30 mW/MHz average EIRP between the 2318-2320 and 2345-2347 MHz portions of the C and D blocks, respectively. Under the WCS Coalition's proposal, the less restrictive spectral mask, which mirrors its previously proposed spectral mask of 55/61/67 + 10 log (P) dB, would be available only if the WCS device uses the power levels noted

²³⁶ Sirius Comments, Exhibit C at C9; Sirius Reply Comments, Exhibit C at 4.

²³⁷ Sirius Comments at 34 and Exhibit A at A16. *See also* Sirius XM Sept. 8, 2008, *Ex Parte* at 14, 15.

²³⁸ *See* WCS Coalition *Ex Parte* filed February 22, 2010.

²³⁹ *See* Appendix E of this *Report and Order* for a description of the test setups in Ashburn, VA.

²⁴⁰ *See* WCS Coalition Aug. 4, 2009, *Ex Parte* at Exhibit B.

above and employs ATPC.²⁴¹ With regard to the WCS Coalition's most recent proposal, Sirius XM believes that these power and OOB levels would result in massive interference to SDARS operations.²⁴²

95. On the other hand, Sirius XM argues that because the Ashburn, VA test area receives the strongest possible signals from Sirius XM's satellites (as much as 6 dB greater in the mid-Atlantic area in which the testing was performed than in other areas of the country) and did not have many obstructions (foliage, buildings, or overpasses) that would attenuate the received satellite signal, the WCS Coalition's testing did not accurately reflect the potential for WCS transmissions to interfere with Sirius XM's transmissions in areas where the satellite signal strength is not as strong. Sirius XM states that even though its testing was done in a geographic area that receives some of the strongest satellite radio signals in the country and has little foliage or other obstructions to diminish reception of the satellite signal, the WCS mobile device still interfered with Sirius XM's signal.²⁴³ Sirius XM believes that its testing in Ashburn shows that the WCS Coalition's power/spectral mask proposal of 250 mW/55/61/67 + 10 log (P) dB will cause harmful interference to SDARS operations, even at a separation distance greater than 25 meters between the WCS transmitter and SDARS receiver and in the presence of a terrestrial repeater.²⁴⁴ To prevent such interference, Sirius XM contends that WCS mobile and portable devices should be restricted to the lower WCS A and B blocks (2305-2315 MHz) with a maximum EIRP of 250 mW (*i.e.*, no mobile devices would be allowed to transmit in the WCS C and D blocks at 2315-2320 and 23450-2350 MHz, respectively, or the upper WCS A and B blocks at 2350-2360 MHz), with 150 mW not being exceeded more than 10 percent of the time, a duty cycle of 6 percent, and with OOB attenuated by a factor of not less than 70 + 10 log (P) dB in the 2320-2345 MHz band.²⁴⁵ Fixed WCS service would still be permitted in the WCS C and D blocks and the upper WCS A and B blocks.

96. Commission staff observed that the SDARS receivers did not mute when only WCS OOB energy was transmitted by the Sirius XM signal generator in the SDARS band while the vehicles hosting the devices were in very close proximity to one another (*i.e.*, in adjacent parking spaces). However, staff observed that the SDARS receivers did mute when a WiMAX signal was generated within certain portions of the WCS bands in the absence of any OOB energy from the signal generator. The Ashburn tests appeared to show that the interference to SDARS receivers was dominated by overload interference since the presence of OOB did not seem to have any material effect on SDARS reception at practical distances between the vehicle installations. Commission staff also observed that the WCS interference primarily occurred from WCS mobile operations in the adjacent WCS C and D blocks, however there was considerably less interference when the WCS mobile device's transmitting frequency was separated from the SDARS band edge by 2.5 megahertz or greater, or if the duty cycle of the WCS device was lowered.

97. *Comments.* In its comments on the Commission staff's proposed interference rules, the WCS Coalition states that although WCS licensees would prefer less restrictive OOB limits on WCS user devices, the WCS OOB limits proposed in the Commission staff's *WCS/SDARS Technical Rules Public Notice* will not preclude the deployment of viable mobile broadband services in the 2.3 GHz WCS

²⁴¹ WCS Coalition Aug. 19, 2009, *Ex Parte* presentation at 14-20

²⁴² See Sirius XM Sept. 3, 2009, *Ex Parte* presentation at 27, 29.

²⁴³ See Sirius XM *Ex Parte* filing dated August 3, 2009, at 3-4.

²⁴⁴ See Sirius XM Aug. 3, 2009, *Ex Parte* at 4.

²⁴⁵ See Sirius XM Jan. 22, 2010, *Ex Parte* presentation at 12. Previously, Sirius XM believed that WCS mobile and portable devices should be restricted to operating in the WCS A and B blocks with an EIRP of 125 mW and OOB attenuated by a factor of not less than 90 + 10 log (P) dB, with fixed operations still permitted in WCS Blocks C and D. See Sirius XM Aug. 11, 2009 *Ex Parte* presentation at 27.

band.²⁴⁶ The WCS Coalition is concerned, however, that further restrictions on WCS OOB levels in excess of those proposed in the *WCS/SDARS Technical Rules Public Notice* could substantially delay the availability of equipment in the United States, or, at worst, prevent vendors from offering user devices that meet the prerequisites – reasonably low costs, small form factors, and extended battery life – for success in the U.S. market.²⁴⁷ To improve the measurement accuracy of OFDMA signals, however, the WCS Coalition proposes that in the one-megahertz bands immediately outside and adjacent to the WCS frequency blocks, measurements for compliance with the WCS OOB limits should be based on a resolution bandwidth of one percent of the emission bandwidth, as provided under the existing procedures for other bands, so long as the measured power is integrated over a one-megahertz bandwidth. The WCS Coalition contends such an approach is needed in the first megahertz on either side of a frequency band being used for wideband technologies that incorporate OFDMA technology, including WiMAX and TD-LTE (Time Division-Long Term Evolution), due to the wideband nature and spectral roll-off characteristic of the OFDMA signal.²⁴⁸

98. In its comments on the *WCS/SDARS Technical Rules Public Notice*, Sirius XM argues that the proposed reduction in the attenuation of WCS OOB to as little as $55 + 10 \log(P)$ dB would not be sufficient to protect SDARS receivers. Further, Sirius XM contends that the proposed limits were tested and shown to cause harmful interference. Also, although Sirius XM acknowledges that the effects of overload interference are dominant, it contends that introduction of OOB will exacerbate the impact of this interference.²⁴⁹ Sirius XM also argues that the WCS demonstration was conducted in an area of the country receiving the strongest possible signals for the Sirius XM satellites.²⁵⁰ (In its comments on the Ashburn testing, Sirius XM noted that other areas of the country receive signals that are as much as 6 dB weaker than the signal that is received in Ashburn.²⁵¹) Sirius XM also filed supplemental comments containing a technical analysis of the impact of WCS out of band emissions from WCS devices on SDARS receivers by Dr. Theodore S. Rappaport, P.E. (Dr. Rappaport's Study).²⁵² Dr. Rappaport compares existing interference protection rules that apply to services adjacent to broadcast services. He also describes the Sirius and XM satellite systems with general consistency with the characteristics provided by Sirius and XM in their earlier comments. Dr. Rappaport oversaw creation of a software simulator to model the WCS OOB impact on SDARS receivers. The details of the simulator, the assumptions used and the results of the simulation are provided in the analysis. He concludes, based on his simulation results in five cities, that to provide sufficient protection to SDARS receivers, WCS mobile and portable devices must be limited to an OOB attenuation of $75 + 10 \log(P)$ dB.²⁵³

²⁴⁶ See Comments of the WCS Coalition, filed April 23, 2010, at 4-5.

²⁴⁷ *Id.* at 5.

²⁴⁸ *Id.*, Appendix A at xi. See also WCS Coalition *Ex Parte* Presentation, filed April 30, 2010, at 2-3. TD-LTE uses TDD unpaired spectrum channels, which alternately use the same channel for uplink and downlink, splitting resources as necessary on the basis of real-time demand, whereas FDD-LTE uses the FDD paired spectrum with two separate channels, one for the uplink and one for the downlink.

²⁴⁹ See Comments of Sirius XM Radio Inc., filed April 23, 2010, at 12-13.

²⁵⁰ *Id.* at 26.

²⁵¹ See Sirius XM *Ex Parte* filing dated August 3, 2009, at 3-4.

²⁵² See "Technical Analysis of the Impact of Adjacent Service Interference to the Sirius XM Satellite Digital Audio Radio Services (SDARS)" by Theodore S. Rappaport, P.E., TELISITE Corp., submitted with Supplemental Comments of Sirius XM, filed April 29, 2010, at 73.

²⁵³ See "Technical Analysis of the Impact of Adjacent Service Interference to the Sirius XM Satellite Digital Audio Radio Services (SDARS)" by Theodore S. Rappaport, P.E., TELISITE Corp., submitted with Supplemental Comments of Sirius XM, filed April 29, 2010, at 73.

99. *Discussion.* We have reviewed all of the various analyses and test results concerning the risk of interference due to OOB from a WCS device. Each side has taken a position which led, at least initially, to a nearly 50-dB difference in their assessments of potential OOB interference.²⁵⁴ Sirius XM had maintained that the interference criteria should be no more than a 1-dB degradation of the SDARS receiver's noise floor. We recognize that its position is based on the need to preserve the maximum margin possible in its link budget to deal with propagation phenomena such as shadowing from trees, buildings, and other objects. The WCS Coalition's position that interference should be based on muting could, on the surface, appear to completely eliminate any margin to provide for reliable satellite reception. We appreciate that such margins serve to provide reliable reception in difficult propagation environments. Yet, consumers will not lose reception simply because of degradation in the link margin unless other factors already are causing weak satellite signals. Moreover, given the complexity of these particular satellite systems which are designed to use multiple satellite feeds and terrestrial signals, the degradation of the margin to one satellite delivery path may have no material effect on the listener experience at various locations. We note, too, that losses in addition to free space loss will exist in a vehicle-to-vehicle scenario, as evidenced in the results from the Ashburn testing discussed earlier. These additional path losses will help to offset the degradation of the satellite link margin and, consequently, mitigate the risk of muting the SDARS receiver.

100. Accordingly, we conclude that it is appropriate to relax the current OOB restriction.²⁵⁵ We require that WCS mobile and portable devices operating in the WCS A and B blocks and the 2.5-megahertz portion of the WCS C and D blocks furthest removed from the SDARS band attenuate their out-of-band emissions, as measured over a 1-megahertz bandwidth, by a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2305-2317.5 MHz and between 2347.5-2360 MHz that are outside the licensed band of operation, not less than $55 + 10 \log (P)$ dB in the 2320-2324/2341-2345 MHz bands, not less than $61 + 10 \log (P)$ dB in the 2324-2328/2337-2341 MHz bands, and not less than $67 + 10 \log (P)$ dB in the 2328-2337 MHz band. OOB must also be attenuated by a factor of not less than $43 + 10 \log (P)$ dB in the 2300-2305 and 2360-2365 MHz bands, not less than $55 + 10 \log (P)$ dB in the 2296-2300 MHz band, not less than $61 + 10 \log (P)$ dB in the 2292-2296 MHz band, not less than $67 + 10 \log (P)$ dB in the 2288-2292 MHz band, and not less than $70 + 10 \log (P)$ dB below 2288 MHz and above 2365 MHz. Several factors weigh in our decision. According to the measurements and technical analyses provided by the commenters, the signal propagation loss will be greater than free space loss between two vehicles. The exact signal attenuation will vary depending on many circumstances including the distance between the vehicles, the use scenario (*e.g.*, whether the transmitting WCS device is held at head or lap height), and the orientation of the WCS antenna with respect to the SDARS receive antenna (*e.g.*, whether it is below, above or in the same plane as the SDARS antenna). Commission staff observed from the Ashburn tests that when using an actual WCS device in a manner that a subscriber would use the system (*e.g.*, placing a VOIP call or uploading/downloading files), there were no observations of muting due solely to OOB. This indicates that signal attenuation plays a significant role in mitigating the potential for WCS OOB interference. The Ashburn tests also underscore the fact that

²⁵⁴ Based on Sirius XM's filing prior to the Ashburn tests showing that its receiver would be muted if the WCS OOB attenuation level in the SDARS band were to reach $94 + 10 \log (P)$ dB, there was a difference of 39 dB in attenuation between the positions of the parties. See Sirius XM Sept. 8, 2008, *Ex Parte* presentation at Exhibit B, at 7.

²⁵⁵ Sirius XM argues that the lowering of the OOB limit is arbitrary and capricious because it is a dramatic and unsupported departure from the prior Commission conclusion that a highly restrictive OOB limit is "required" to protect SDARS spectrum, and that no technical explanation could justify this "complete about-face." See Comments of Sirius XM, filed April 23, 2010, at 44-45. However, it is well within our authority to change our rules and standards in a rulemaking, so long as we provide a reasoned explanation for doing so. As detailed herein, we believe that the OOB limits we are adopting are appropriately tailored to accomplish our dual policy goals of enabling the provision of mobile broadband services in the WCS spectrum, while protecting SDARS operations from harmful interference.

the satellite link margin was not entirely eliminated during the numerous test points since receiver muting did not occur.

101. We note, however, that neither the Sirius satellites nor the XM satellites provide coverage of the conterminous United States at a uniform power level. Under the Agreement Between the Government of the United States of America and the Government of the United Mexican States Concerning the Use of the 2310-2360 MHz Band, the power flux density level of the Sirius satellites at the U.S.-Mexico border is limited to -126.5 dBW/m²/4 kHz, and the power flux density level of the XM satellites at the U.S.-Mexico border is limited to -122.0 dBW/m²/4 kHz. These limits constrain the power levels the SDARS satellites can transmit into the southwest part of the United States, while allowing higher power levels further north. Sirius and XM have designed their geostationary satellites to provide higher power levels into the heavily-populated areas of the East and West Coasts of the United States than along the southern border. The physics constraints of satellite antenna design are such that the power level of the Sirius and XM downlink signals must taper off gradually, rather than abruptly as the downlink antenna patterns approach the southern border.

102. Although the power of Sirius XM's satellite signals in the southern portion of the United States is lower than in the northern portion, we believe that the WCS mobile and portable devices' power and OOB limits we are adopting, coupled with the limits on these devices' duty cycle, the requirement that they employ ATPC, and the 2.5-megahertz WCS guard bands on both sides of the SDARS band, will be sufficient to limit the potential for harmful interference to SDARS receivers in those areas of the United States that receive relatively lower-power satellite signals. In our judgment, because the testing showed that potential for harmful interference from WCS mobile and portable devices is negligible, it is reasonable to conclude that there will not be an appreciable increase in the potential for WCS mobile and portable devices to interfere with SDARS receivers, even though Sirius XM's signal level is less in some portions of the United States.

103. In supplemental comments on the Commission staff's *WCS/SDARS Technical Rules Public Notice*, Sirius XM submitted an assessment on the probability of WCS interference to SDARS service performed by Dr. Theodore S. Rappaport, P.E., of the Telisite Corporation.²⁵⁶ We commend Sirius XM for supporting development of a Monte-Carlo model for analysis of Mobile Satellite reception. As an initial matter, however, although Dr. Rappaport characterizes Sirius XM's service as a broadcast service, we believe that their service is more akin to a subscription-based direct broadcast satellite service (DBS) offering.²⁵⁷

104. In Dr. Rappaport's software simulator, he uses SDARS receiver parameters generally consistent with what Sirius XM have provided in the record. With regard to path loss between the WCS and SDARS terminals, he uses path losses with exponents of either 2.0 (free space, as suggested by Sirius XM) or 2.18 (as suggested by the WCS Coalition) and an additional loss factor, described by a Gaussian random variable having a mean of either 10 or 16 dB and a standard deviation of 0, 2, or 4 dB to simulate different use cases;²⁵⁸ he indicates that both the Sirius XM and WCS propagation loss data are well-matched by one of the resulting parameter combinations. The simulator permits the distance between a WCS transmitter and an SDARS receiver to be as small as 3 meters (about 10 feet) to simulate congested conditions across multiple traffic lanes. We believe that such conditions are most likely to exist in urban areas. However, the model does not consider terrestrial repeaters, and apparently does not

²⁵⁶ See Supplemental Comments of Sirius XM Radio, Inc. filed April 29, 2010.

²⁵⁷ Under the Commission's Rules, a broadcasting-satellite service is a radiocommunication service in which signals transmitted or retransmitted by space stations are intended for direct reception by the general public. 47 C.F.R. § 2.1(c).

²⁵⁸ See Supplemental Comments of Sirius XM Radio, Inc. filed April 29, 2010, Dr. Rappaport's Study at 20.

consider the 4-second buffer contained in SDARS receivers, which allows, for example, for uninterrupted reception as a vehicle passes under an overpass resulting in momentary loss of the satellite signals. The model also appears to assume that WCS transmitters operate in the frequency blocks nearest the SDARS receiver²⁵⁹ (i.e., it is never assumed that a WCS transmitter in Block D (in the upper WCS band) could be operating near a Sirius receiver (in the lower SDARS band) or that a WCS transmitter in Block C (in the lower WCS band) could be operating near an XM receiver (in the upper SDARS band)). We believe that this assumption overstates the likelihood of interference, since all SDARS receivers are always assumed to be experiencing WCS transmissions that have the highest OOB level. Finally, the model assumes constant gain of the SDARS receive antenna with elevation angle. We note that Sirius XM appears to have no gain specification within 20 degrees of the horizon for SDARS receive antennas, and that some SDARS vehicular receive antennas have gains that are 7-10 dB below the nominal, specified value at elevation angles within 15 degrees of the horizon.²⁶⁰

105. Other parameters can be adjusted by the user of the software, but for the simulations submitted by Sirius XM, it is assumed that 34 percent of all vehicles on the road have on-board SDARS receivers, which are in use 85 percent of the time, and that WCS transmitters are installed in 5 percent of all vehicles and are transmitting 13 percent of the time. We note that the current number of Sirius XM subscribers is less than 19 million,²⁶¹ while there are over 240 million vehicles (of which 134 million are cars).²⁶²

106. We believe that the assumed 3-meter separation between SDARS and WCS units conflicts with the assumption of no terrestrial repeater service, since such repeaters are installed primarily in urban areas where congested traffic across multi-lane roads is most likely to occur. Further, we note that SDARS terrestrial repeaters transmit further into the SDARS frequency band that are also subject to lower OOB from WCS devices. We also believe that vehicle-mounted SDARS receive antennas will generally provide significant isolation from WCS operations in nearby vehicles since the elevation angle associated with reception of the WCS signal will generally be low (or nearly horizontal). Finally, while reductions in link margin are useful indicators of reliability, we note that both parties have agreed that a muted SDARS receiver defines interference and the simulations do not provide insight on whether or when actual muting will occur.²⁶³

107. In our judgment, the modified WCS mobile and portable devices' operating power and OOB limits we adopt will prevent interference to SDARS operations except in the rarest of instances when a number of WCS and SDARS operating conditions coincide (e.g., WCS mobile device in close proximity to SDARS receiver, high degree of mutual coupling between WCS and SDARS antennas, lack of obstructions between WCS transmitter and SDARS receiver, WCS mobile device transmitting channel is immediately adjacent to SDARS receiving channel, etc.).

²⁵⁹ See Supplemental Comments of Sirius XM Radio, Inc. filed April 29, 2010, Dr. Rappaport's Study at 41.

²⁶⁰ Licul, S., et al., "Reviewing SDARS Antenna Requirements," Microwaves and RF, September 2003, available from <http://www.mwrf.com/Articles/Print.cfm?ArticleID=5892>

²⁶¹ Sirius XM's SEC Form 10-Q, filed May 7, 2010, lists 18,944,199 total subscribers; 9,157,165 subscribers on the SIRIUS system and 9,787,034 subscribers on the XM system, as of March 31, 2010. See Sirius XM's SEC Form 10-Q, available at http://www.faqs.org/sec-filings/100507/SIRIUS-XM-RADIO-INC_10-Q/.

²⁶² http://www.census.gov/Press-Release/www/releases/archives/facts_for_features_special_editions/012439.html (retrieved May 13, 2010)

²⁶³ See, e.g., Comments of Sirius XM, filed April 23, 2010, at 33; WCS Coalition *Ex Parte* presentation, filed May 13, 2010, at 2-4.

108. The arguments from Sirius XM for a more severe OOB limit would, in effect, maintain the *de facto* preclusion of mobile devices from operating in the WCS spectrum. Our current rules permit mobile operations on their face but apply such a severe OOB limit that no mobile operation is feasible. As a result, there have been no mobile operations in the WCS spectrum and continuing to apply a severe OOB limit would surely perpetuate the *status quo*. We find this situation unacceptable because it effectively makes valuable spectrum unusable for the provision of mobile broadband services, despite results from the Ashburn tests that indicate that highly restrictive OOB limits, such as the current OOB restriction or the limits proposed by Sirius XM, are not necessary to protect satellite radio operations.

109. In the past, the Commission has generally established OOB limits based on factors such as the impact on the viability of service and a general assessment of the risk of harmful interference.²⁶⁴ This approach has generally been successful. For example, the service rules adopted for the 1710-1755 MHz/2110-2155 MHz AWS-1 bands have fostered the nationwide provision of mobile broadband services using that spectrum.²⁶⁵ The stepped emissions limit proposed by the WCS Coalition is 12 dB more stringent for the outer satellite channels than our typical OOB limit of $43 + 10 \log(P)$ dB and is 24 dB more stringent for the inner satellite channels. We note that Sirius XM is opposed to the stepped OOB limit approach recommended by the WCS Coalition because it claims this inappropriately provides more protection to one satellite feed than another.²⁶⁶ We do not agree that this is a valid objection. Because the WCS Coalition's proposed OOB attenuation factors will provide adequate interference protection for the outer satellite channels of the SDARS band, due to the roll-off (*i.e.*, further attenuation) of a signal that is passed through a typical radio frequency filter, additional protection will be available to the terrestrial repeater channels towards the middle of the SDARS band, and still further protection will be available to the inner satellite channels in the middle portion of the SDARS band.

110. There is also precedent in the rules for a stepped OOB limit. In establishing OOB limits for the BRS and EBS operating in the 2496-2500 MHz band, including OOB limits to protect the Mobile Satellite Service (MSS) operating below 2495 MHz, the Commission specified an emissions limit of not less than $43 + 10 \log(P)$ dB at the channel edge and not less than $55 + 10 \log(P)$ dB at 5.5 megahertz from the channel edge.²⁶⁷ Therefore, the limit proposed by the WCS Coalition is also more stringent than the limit we have applied to adjacent band BRS and EBS operations in order to protect Mobile Satellite Service (MSS) operations from harmful interference.

²⁶⁴ See, e.g., Service Rules for the 698-746, 747-762 and 777-792 MHz Bands, WT Docket No. 06-150, Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems, CC Docket No. 94-102, Section 68.4(a) of the Commission's Rules Governing Hearing Aid-Compatible Telephones, WT Docket No. 01-309, Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services, WT Docket 03-264, Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission's Rules, WT Docket No. 06-169, Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band, PS Docket No. 06-229, Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010, WT Docket No. 96-86, Declaratory Ruling on Reporting Requirement under Commission's Part 1 Anti-Collusion Rule, WT Docket No. 07-166, *Second Report and Order*, 22 FCC Rcd 15289, 15418 ¶ 361 (2007) (*Second Report and Order*) recon. pending; Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands, WT Docket No. 02-353, *Report and Order*, 18 FCC Rcd 25162 (2003) (*AWS-1 Service Rules Order*); *Order on Reconsideration*, 20 FCC Rcd 14058 (2005).

²⁶⁵ See Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services, WT Docket No. 08-27, *Thirteenth Report*, 24 FCC Rcd 6185, 6256 ¶ 140 (rel. Jan. 16, 2009).

²⁶⁶ See Sirius XM *Ex Parte* Presentation at 3 (filed November 13, 2008).

²⁶⁷ See 47 C.F.R. Section 27.53(l)(4).

111. On balance, we conclude that the OOB limits proposed by the WCS Coalition are reasonable and sufficient to protect SDARS receivers from harmful interference without precluding the operation of mobile and portable devices in the WCS spectrum. Thus, for WCS mobile and portable devices operating in the WCS A and B blocks and the 2.5-megahertz portions of the WCS C and D blocks furthest removed from the SDARS band, we are adopting OOB attenuation factors of not less than $43 + 10 \log (P)$ dB on all frequencies in the 2305-2317.5/2347.5-2360 MHz bands that are outside the licensed band of operation, not less than $55 + 10 \log (P)$ dB in the 2320-2324/2341-2345 MHz bands, not less than $61 + 10 \log (P)$ dB in the 2324-2328/2337-2341 MHz bands, and not less than $67 + 10 \log (P)$ dB in the 2328-2337 MHz band. As indicated above, these stepped limits should provide sufficient protection to the outer SDARS channels used at the satellites, slightly greater protection to the SDARS channels used by the terrestrial repeaters, and still greater protection to the inner SDARS channels used by the satellites. We anticipate that interference will occur very rarely under these limits. For interference to occur, the WCS device would have to be transmitting at full power at the exact moment that it is within a few meters of the SDARS receiver and there is no satellite diversity or terrestrial repeater is present. As discussed in more detail below, in order to protect aeronautical mobile telemetry (AMT) service operations in the adjacent 2360-2395 MHz band from harmful interference, OOB for WCS mobile and portable devices must also be attenuated by a factor of not less than $43 + 10 \log (P)$ dB in the 2360-2365 MHz band and not less than $70 + 10 \log (P)$ dB above 2365 MHz. To protect deep space network (DSN) operations in the second adjacent 2290-2300 MHz band from harmful interference, WCS mobile and portable devices' OOB must be attenuated by a factor of not less than $43 + 10 \log (P)$ dB in the 2300-2305 MHz band, not less than $55 + 10 \log (P)$ dB in the 2296-2300 MHz band, not less than $61 + 10 \log (P)$ dB in the 2292-2296 MHz band, not less than $67 + 10 \log (P)$ dB in the 2288-2292 MHz band, and not less than $70 + 10 \log (P)$ dB below 2288 MHz. We believe that applying these stepped OOB masks for the upper and lower adjacent spectrum will allow for full use of the WCS A and B blocks and 2.5 megahertz of both the WCS C and D blocks with equipment that is currently available, while also allowing for the interference potential with AMT and DSN to be addressed with reasonable coordination requirements.

112. Although the typical measurement bandwidth used in measuring compliance with specific OOB attenuation factors is 1 megahertz, because we are requiring that WCS devices' OOB be attenuated by a specific amount at the band-edge frequency, in the one-megahertz bands immediately outside and adjacent to the WCS channel blocks at 2305, 2310, 2315, 2320, 2345, 2350, 2355, and 2360 MHz, measurements for compliance with the WCS OOB limits may be based on a resolution bandwidth of 1 percent of the emission bandwidth, so long as the measured power is integrated over a 1-megahertz bandwidth. As noted by the WCS Coalition, this should improve the OOB measurement accuracy for OFDMA signals in the one-megahertz bands immediately outside and adjacent to the WCS frequency blocks.²⁶⁸

113. We will, however, also employ the same approach to OOB interference protection of SDARS operations that we apply to protect SDARS operations from overload interference. Specifically, WCS licensees must cooperate in good faith in the selection and use of new station sites and new frequencies to reduce interference and make the most effective use of the authorized facilities. Licensees of stations suffering or causing harmful interference must cooperate in good faith and resolve such problems by mutually satisfactory arrangements. If the licensees are unable to do so, the Wireless Telecommunications Bureau, in consultation with the Office of Engineering and Technology and the International Bureau, may impose greater OOB attenuation than described above.²⁶⁹

²⁶⁸ See WCS Coalition *Ex Parte* Presentation, filed April 30, 2010, at 2-3.

²⁶⁹ 47 C.F.R. § 27.53(n).

E. WCS Base and Fixed Station and Customer Premises Equipment Power and Out-of-Band Emissions Limits

114. In the *2007 Notice*, we sought comment on the WCS Coalition's proposal that we adopt a 2-kW EIRP average power limit for WCS fixed and base stations.²⁷⁰ We specifically asked interested parties to address what impact, if any, adoption of an average, rather than peak, power limit for WCS base stations would have on the ability of WCS licensees to deploy new services, and whether it would increase the risk of interference with adjacent channel licensees outside of the 2305-2360 MHz range.²⁷¹ We also requested comment on whether the Commission should adopt a 6-dB PAPR (peak-to-average power ratio) proposed by the WCS Coalition, or whether a different PAPR, such as 13 dB, which the Commission adopted for wireless services in the 700 MHz band²⁷² and more recently for services in certain PCS/AWS bands,²⁷³ would be more appropriate.

115. In the *2007 Notice*, the Commission also invited comment on three proposals for power limits for SDARS terrestrial repeaters and WCS transmitting stations. One proposal, from Sirius, is to limit ground-level emission levels. The second, proposed by WCS licensees, is to limit average EIRP and the ratio between average and peak EIRP. The third proposal is a hybrid of the ground-level emission limit and the average EIRP limit. We discuss each of these proposals in more detail below.

116. In its *2006 Petition for Rulemaking*, Sirius asserted that the Commission could limit interference between SDARS repeaters and WCS stations by establishing a "ground-level emission limit" of -44 dBm for both SDARS terrestrial repeaters and WCS stations.²⁷⁴ To verify compliance, Sirius proposes that the received power from either an SDARS repeater or a WCS base station would be measured at a height of 2 meters above ground level, at a distance from the base of the antenna that is equal or greater than the effective height above ground level of the SDARS or WCS station's antenna.²⁷⁵ Additionally, under Sirius' proposal, the average power received at a distance of 1 meter from a transmitting WCS subscriber station's antenna would also be limited to -44 dBm.²⁷⁶ In its comments on

²⁷⁰ *2007 Notice*, 22 FCC Rcd at 22141 ¶ 22.

²⁷¹ *Id.*

²⁷² See Service Rules for the 698-746, 747-762 and 777-792 MHz Bands, *Report and Order and Further Notice of Proposed Rulemaking*, 22 FCC Rcd 8064, 8103-04 ¶¶ 105-06 (2007) ("700 MHz Report and Order").

²⁷³ See Biennial Regulatory Review—Amendment of Parts 1, 22, 24, 27 and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services, WT Docket No. 03-264, *Third Report and Order*, 23 FCC Rcd 5319, 5336-37 ¶¶ 29-42 (2008) ("Streamlining Third Report and Order").

²⁷⁴ *2006 Petition for Rulemaking* at 4-5, cited in *2007 Notice*, 22 FCC Rcd at 22129 ¶ 15. XM and Sirius have referred to the proposed "ground-level emission limit" as a power flux density (PFD) limit. Letter from Carl R. Frank, Counsel for XM/Sirius, to Secretary, FCC (dated Aug. 14, 2006) at 1; Letter from Patrick L. Donnelly, Executive Vice President, General Counsel, and Secretary, Sirius, and James S. Blitz, Vice President and Regulatory Counsel, XM Radio Inc., to Marlene H. Dortch, Secretary, FCC (dated Sept. 19, 2007) at 7-8 and Annex 2. In the *2007 Notice*, however, the Commission explained that the ground-level emission limit is actually a received power limit (similar to the limits on incidental radiator emissions in Section 15.209 of the Commission's Rules, 47 C.F.R. § 15.209). The Commission explained further that a rule incorporating Sirius' basic idea could be expressed as an equivalent power flux density (PFD) or electric field strength limit. Assuming a 0 decibel over isotropic (dBi) measurement antenna (as Sirius does), the -44 dBm received power limit is equivalent to a PFD limit of -45.3 dBW/m² or a field strength limit of 100.5 dBµV/m. *2007 Notice*, 22 FCC Rcd at 22129 n.42.

²⁷⁵ See *2006 Sirius Petition for Rulemaking*, Appendices A, proposed Section 25.214(d)(2)(A)(i), and B, proposed Section 27.50(a)(1)(A), cited in *2007 Notice*, 22 FCC Rcd at 22129 ¶ 15.

²⁷⁶ See *2006 Sirius Petition for Rulemaking*, Appendix B, proposed Section 27.50(a)(1)(C), cited in *2007 Notice*, 22 FCC Rcd at 22129 ¶ 15. SDARS subscriber units are receivers only and do not transmit. Therefore, Sirius did not propose a similar provision for SDARS.

the Commission staff's *WCS/SDARS Technical Rules Public Notice*, Sirius XM reiterated its position on ground-based emission limits as a means of limiting interference to SDARS. It also added that the Commission should require that the WCS network be deployed with a cell density such that a power level greater than -44 dBm would not be present for greater than 100 meters of continuous road surface.²⁷⁷

117. In the *2007 Notice*, the Commission requested that interested parties discuss whether a ground-level emission limit – of the kind proposed by Sirius – would facilitate the deployment of both SDARS and WCS services to the public. Specifically, parties were requested to discuss the interference potential of a -44 dBm limit on WCS and SDARS operations, and to balance that potential with the economic and business impact of such a limit on WCS and SDARS operations. In addition, the Commission sought comment on how easily it could verify compliance with and resolve disputes arising under a ground-level emission limit requirement.²⁷⁸

118. The Commission also encouraged parties to propose alternative ground-level emission limits, and to provide technical studies demonstrating the effect such alternative limits would have on the ability of SDARS and WCS licensees to serve the public. Further, the Commission stated that it would consider an equivalent power flux density (PFD) limit expressed in dBW/m², or a field strength limit expressed in dBμV/m, because such a limit would eliminate the need to make an assumption about receiver antenna gain. The Commission asked parties to recommend the bandwidth to be used in calculation of a PFD limit if it were to adopt such a limit.²⁷⁹

119. As an alternative to Sirius' ground-level emission limit proposal, WCS licensees proposed allowing both WCS base stations and SDARS repeaters to operate with an EIRP up to 2 kW, based on average rather than peak power, per 5 megahertz, with a 6 dB PAPR.²⁸⁰ The WCS licensees further proposed a power spectral density limit such that only 400 W average EIRP could be emitted per 1 megahertz, to ensure the transmitted energy is spread across the band.²⁸¹

120. In the *2007 Notice*, the Commission asked several questions regarding the WCS Coalition's proposal and the methodology on which it is based. For example, the Commission asked whether the adoption of a 2-kW EIRP average power limit would permit the deployment of WCS services to the public. The Commission also asked whether the adoption of an average rather than a peak power limit for WCS stations would have any effect on the ability of the licensees to deploy their services. The Commission also requested comment on whether to adopt the 6-dB PAPR suggested by the WCS Coalition, or whether a different ratio may be more appropriate, such as a PAPR of 13 dB, which was adopted for wireless services in the 700 MHz band. Finally, the Commission requested parties to discuss whether an average, rather than a peak, power limit would increase the risk of interference with adjacent channel licensees, whether they are WCS or SDARS licensees, or licensees outside of the 2305-2360 MHz range.²⁸²

²⁷⁷ See Comments of Sirius XM Radio Inc., filed April 23, 2010, at 32.

²⁷⁸ *2007 Notice*, 22 FCC Rcd at 22130 ¶ 18.

²⁷⁹ *2007 Notice*, 22 FCC Rcd at 22130 ¶ 18.

²⁸⁰ WCS Coalition July 9, 2007, *Ex Parte* at 3-4, cited in *2007 Notice*, 22 FCC Rcd at 22131 ¶ 21. As proposed by the WCS Coalition, average EIRP would be calculated using the average power of the transmitter measured in accordance with the definition of "mean power" in Section 2.1 of the Commission's rules.

²⁸¹ WCS Coalition July 9, 2007, *Ex Parte* at 3, Appendix A, proposed Sections 27.50(a)(1) and 25.XX(a), cited in *2007 Notice*, 22 FCC Rcd at 22131 ¶ 21.

²⁸² *2007 Notice*, 22 FCC Rcd at 22131 ¶ 22.

121. Finally, the Commission invited interested parties to discuss whether a hybrid power approach might be appropriate. The Commission explained that such an approach would give SDARS licensees flexibility to place their repeaters on high towers and operate them with more power if they meet a certain emission limit on the ground, while WCS would have the flexibility to meet an average EIRP limit using towers lower to the ground.²⁸³ The Commission observed that it adopted a similar approach for the lower 700 MHz band, where commercial base stations must meet an effective radiated power (ERP) limit of 1 or 2 kW, depending on whether they are deployed in rural areas, but such stations could also transmit at 50 kW ERP if they do not produce signals exceeding a PFD of 3 mW/m² on the ground within 1 kilometer (km) of the station.²⁸⁴ Further, the Commission invited commenters to suggest specific power limits to be used in a hybrid approach if such an approach is adopted.²⁸⁵

122. The WCS Coalition states that allowing WCS base stations to operate with an average rather than peak power limit of 2 kW EIRP will enable WCS licensees to match the power level of SDARS terrestrial repeaters if necessary to avoid interference to WCS mobile stations.²⁸⁶ Motorola supports the WCS Coalition's proposal to apply average power,²⁸⁷ arguing that an average EIRP limit would be consistent with the power limits that the Commission adopted for the 700 MHz band.²⁸⁸ Motorola asserts that applying a non-constant envelope to WCS would better accommodate transient power surges of short duration.²⁸⁹

123. Sirius XM argues that the need to increase power limits for WCS base stations to a maximum of 2 kW EIRP average power is not well documented, and appears to only function as a means to achieve parity with SDARS technical standards.²⁹⁰ Moreover, it argues that increasing the base station power limit to 2 kW EIRP average power would quadruple the amount of harmful interference to SDARS receivers.²⁹¹ Sirius also submits that the average power should be measured at the 0.01 percent probability level.²⁹² In response, the WCS Coalition argues that its proposal for use of average measurements, coupled with a proposed power spectral density limit of 400-W average EIRP per megahertz, will substantially reduce overload interference from WCS licensees.²⁹³ The WCS Coalition asserts that under current Part 27 rules, a WCS licensee is free to transmit multiple narrow band (including 200-kilohertz wide) carriers at 2-kW peak EIRP each; accordingly, its proposal results in less potential for overload interference, not more.²⁹⁴ Sirius XM proposes to keep the technical rules as they currently exist in Part 27 for WCS Blocks C and D, allow more flexibility to enable mobile operations in

²⁸³ 2007 Notice, 22 FCC Rcd at 22131-32 ¶ 23.

²⁸⁴ 2007 Notice, 22 FCC Rcd at 22131-32 ¶ 23, citing 47 C.F.R. §§27.50(c), 27.55(b).

²⁸⁵ 2007 Notice, 22 FCC Rcd at 22131-32 ¶ 23.

²⁸⁶ WCS Coalition Comments at 25-26.

²⁸⁷ Motorola Comments at 3-4.

²⁸⁸ Motorola Comments at 4. See also WCS Coalition Reply Comments at 44.

²⁸⁹ Motorola Comments at 4-5.

²⁹⁰ Sirius XM Sept. 8, 2008, *Ex Parte* at 18.

²⁹¹ Sirius Comments at 19-20, Sirius Reply Comments at 30-32, XM Comments at 32-33.

²⁹² See Sirius' Reply Comments Technical Appendix in Support of Reply Comments IB Docket No. 95-91 and ET Docket No. 07-293, Exhibit D at 5.

²⁹³ WCS Coalition Reply Comments at 42-43.

²⁹⁴ WCS Coalition Reply Comments at 43.

WCS Blocks A and B provided that Blocks C and D serve as appropriate guard bands to satellite radio, and that there are appropriate restrictions on WCS devices' maximum power and OOB limits.²⁹⁵

124. Finally, in the *2007 Notice*, the Commission requested comment on the WCS Coalition's proposal to relax the base station OOB attenuation requirement of $80 + 10 \log (P)$ dB.²⁹⁶ Specifically, the Commission sought comment on the WCS Coalition's proposal to require WCS and SDARS licensees to attenuate emissions into each other's band by a factor of $75 + 10 \log (P)$ dB.²⁹⁷ In response to the *2007 Notice*, the WCS Coalition reiterated its support for a relaxed OOB attenuation requirement of $75 + 10 \log (P)$ dB.²⁹⁸ Sirius XM also supports relaxing the emission mask for WCS base stations. XM proposed that we adopt an OOB attenuation of $75 + 10 \log (P)$ dB, measured in a 1-megahertz bandwidth, with ground-level emission limits of 100 dB μ V/m (-44 dBm isotropic equivalent power) for WCS Blocks A and B and 90 dB μ V/m (-55 dBm isotropic equivalent power) for WCS Blocks C and D.²⁹⁹ Sirius likewise urges us to relax the WCS base station's OOB attenuation factor to $75 + 10 \log (P)$ dB, measured over a 1-megahertz bandwidth, subject to ground-level emission limits.³⁰⁰

125. In its comments on the Commission staff's proposed rules, Sirius XM contends that the proposed rules will not prevent interference from WCS base stations. Sirius XM submits that this is why, in 2006, it urged the Commission to impose ground-based emissions levels limits on all 2.3 GHz licensees to avoid the creation of "hot spots" that would result in overload interference to adjacent-band receivers. Sirius XM claims its study of 2.5 GHz-band WiMAX devices currently operating in Philadelphia showed large areas surrounding base stations where the base station power level would mute satellite radio receivers. Further, Sirius XM argues that the proposed rules only obligate WCS licensees to select base station sites and frequencies that will minimize the potential for harmful interference to SDARS receivers, but do not provide any meaningful opportunity for Sirius XM to work with WCS licensees to mitigate interference from WCS base stations.³⁰¹ To limit the potential for harmful interference from WCS base stations, Sirius XM requests that the Commission set ground-level emissions limits near WCS base stations. Furthermore, Sirius XM believes that the Commission should require that the WCS network be deployed with a cell density such that a power level greater than -44 dBm would not be present for greater than 100 meters of continuous road surface on major and secondary roads.³⁰² Sirius XM also urges the Commission to require WCS and SDARS licensees to negotiate and enter into a written coordination agreement governing base station deployment, defining harmful interference to SDARS to mean muting of SDARS receivers, obligating WCS licensees to resolve harmful interference if it occurs, establishing an expedited procedure for Commission adjudication in the event of disputes, and imposing significant penalties on WCS licensees who cause interference to SDARS receivers.³⁰³ In addition, Sirius XM asserts that more specific processes are needed to define and assess interference, to

²⁹⁵ Sirius XM Nov. 6, 2008, *Ex Parte* at 8.

²⁹⁶ See *2007 Notice*, 22 FCC Rcd at 22142 ¶ 24.

²⁹⁷ See *id.*

²⁹⁸ WCS Coalition Comments at 21.

²⁹⁹ XM Comments at 34-35, Exhibit A at 7.

³⁰⁰ Sirius Comments at 25, Exhibit A at A12. Although SDARS licensees initially supported the same OOB limit for both WCS base stations and terrestrial repeaters (see, e.g., Sirius Comments at 25, Exhibit A at A12; XM Comments at 34-35, Exhibit A at 7), Sirius XM recently recommended the more stringent OOB attenuation of $90 + 10 \log (P)$ dB for SDARS terrestrial repeaters. See e.g. Sirius XM September 8, 2008, *Ex Parte* at 18.

³⁰¹ See Comments of Sirius XM Radio Inc., filed April 23, 2010, at 21-22.

³⁰² *Id.* at 32.

³⁰³ *Id.* at 32-33.

respond to interference claims, and to resolve interference complaints that the parties cannot resolve themselves.³⁰⁴ In particular, it calls for at least 180-days notice prior to any WCS base station offering service to the public.³⁰⁵

126. For WCS CPE, Sirius XM recommends that the OOB on all frequencies in the 2320-2345 MHz SDARS band be maintained at the existing $80 + 10 \log (P)$ dB limit. In support of this recommendation, Sirius submits that WCS licensees have not submitted any data or analysis into the record, such as the propagation losses associated with WCS CPE located within a home or apartment, as opposed to a vehicular environment, that would warrant modification of CPE devices' OOB as proposed by the Commission. Sirius XM also believes that the Commission should apply the proposed 2.5-megahertz WCS mobile and portable device guard band to include WCS fixed CPE. Finally, because it contends that its technical study show a greater interference potential from wider bandwidth WCS signals, Sirius XM believes that the Commission should establish a maximum occupied bandwidth of five megahertz, which it contends is consistent with every technical submission filed by WCS licensees to support their recommended rule changes.³⁰⁶

127. In its comments on the Commission staff's proposed rules, the WCS Coalition submits that because no party to this proceeding has suggested precluding point-to-point FDD links from operating in the 2305-2320 MHz portion of the WCS band, the Commission should not restrict WCS FDD fixed stations from transmitting in the 2305-2320 MHz WCS band. Thus, the WCS Coalition suggests that the proposed rule be modified to reflect the Commission's presumed intent to require FDD systems to use the lower WCS bands for mobile-to-base station transmissions and use the upper WCS bands for base station-to-mobile transmissions. If the Commission decides to prohibit fixed FDD transmissions in the 2305-2320 MHz band, however, to avoid customer dislocation and stranded investment, the WCS Coalition believes it should consider grandfathering existing FDD point-to-point deployments constructed prior to adoption of the new technical rules.³⁰⁷

128. Stratos Offshore Services Company (Stratos) operates 200 WCS fixed point-to-point transmitters on its WCS spectrum within the Gulf of Mexico service area that provide vital services to the oil and gas industry.³⁰⁸ Because these station pair channels in the 2305-2320 MHz band for communications in one direction with channels in the 2345-2360 MHz band for communications in the reverse direction, Stratos submits that the Commission should not adopt a rule that precludes point-to-point FDD fixed links in the lower WCS bands.³⁰⁹ However, if the Commission is disposed to adopting such a requirement for mobile FDD systems, Stratos suggests that it should clarify in the rule that mobile systems using FDD technology are restricted to utilizing the 2305-2320 MHz band for mobile-to-base station transmissions and the 2345-2360 MHz band for base station-to-mobile transmissions. Stratos contends that such a clarification would remove any risk of ambiguity as to whether the Commission has eliminated the present ability of WCS licensees to deploy FDD point-to-point systems utilizing both segments of the WCS band and provide Stratos with the regulatory

³⁰⁴ See Comments of Sirius XM Radio Inc. at 2 (filed May 13, 2010).

³⁰⁵ *Id.*, Attachment at 1.

³⁰⁶ *Id.* at 34-35

³⁰⁷ See Comments of the WCS Coalition, filed April 23, 2010, Appendix A at ix.

³⁰⁸ See Comments of Stratos Offshore Services Company, filed April 23, 2010, at 2

³⁰⁹ *Id.* at 3-4.

certainty it needs to continue operating and expanding its FDD point-to-point network to meet the needs of the oil and gas industry in the Gulf of Mexico.³¹⁰

129. Based on our analysis of the record before us and a balancing of the Commission's objectives in this proceeding, we adopt, in part, WCS Coalition's proposal regarding base station power limits in WCS Blocks A and B, and we adopt, in part, Sirius XM's proposal regarding base station power limits in WCS Blocks C and D. We conclude that the relative placement of the WCS spectrum blocks in relation to SDARS operations requires that we establish different power level parameters for the A and B blocks than for the C and D blocks. However, as we discuss below, the differing parameters we have developed will provide WCS licensees with operational flexibility as well as safeguard SDARS operations from harmful interference. We also clarify that fixed FDD transmitters are not prohibited from transmitting in the 2305-2320 MHz WCS band.

1. WCS Base and Fixed Station Power Limits (WCS Blocks C and D)

130. Our analysis of the record leads us to conclude that, in order to appropriately balance the interests of both SDARS and WCS licensees, we cannot revise the base station power limits for the WCS C and D blocks as requested by the WCS Coalition. As noted above, WCS Blocks C and D effectively sandwich the 2320-2345 MHz SDARS band. Accordingly, base station operations in WCS Blocks C and D inherently pose more risk of potential interference to satellite radio users than would base station operations in WCS Blocks A and B, which are separated from the SDARS spectrum by at least 5 megahertz. We agree with Sirius XM that a 2-kW average EIRP limit over 5 megahertz should not be adopted for WCS Blocks C and D given the proximity of the C and D blocks to SDARS spectrum.³¹¹ A review of the technical analyses submitted by the commenters leads us to conclude that, in light of the sensitive nature of the SDARS receivers, applying base station power limits on an average versus peak power basis in spectrum immediately adjacent to the SDARS band would unacceptably increase the potential for harmful interference to satellite radio operations.³¹² Accordingly, we make no changes to the 2-kW peak power limit and OOB limit for WCS base station operations in WCS Blocks C and D. However, as noted by the WCS Coalition, Section 27.50(a)(1), as it exists currently, does not expressly preclude WCS licensees from meeting the 2-kW EIRP peak power limit on a per emissions basis, which could cause overload interference to SDARS receivers.³¹³ Thus, in order to protect SDARS receivers from overload interference, we are amending Section 27.50(a)(1) to clarify that WCS base stations in WCS Blocks C and D are limited to 2-kW peak EIRP over 5 megahertz (*i.e.*, 400 W/MHz).

2. WCS Base and Fixed Station Power Limits (WCS Blocks A and B)

131. Because WCS blocks A and B are separated from SDARS spectrum by at least 5 megahertz, we believe that the application of average power limits to these blocks of spectrum does not raise the same interference concerns with regard to SDARS. The use of an average power limit, however, will allow an increase in power levels for WCS operations, particularly those using non-constant envelope

³¹⁰ *Id.* at 5-6.

³¹¹ Letter from Robert L. Pettit, Counsel to Sirius XM Radio, Inc, to Marlene H. Dortch, Secretary, FCC (dated Oct. 2, 2008), at 9 (Sirius XM Oct. 2, 2008, *Ex Parte*).

³¹² Even if the current "peak" EIRP limit of 2 kW was used on a per emission basis by four 1.25-megahertz-wide emissions (*i.e.*, the smallest bandwidth emissions that can be used for WiMAX, which is the projected use of the WCS bands) over 5 megahertz, the horizontal separation needed to avoid harmful interference to SDARS operations will be less than the separation needed if an "average" EIRP limit of 2 kW over 5 megahertz with a PAPR of 13 dB were used in WCS Blocks C and D.

³¹³ See WCS Coalition May 5, 2008, *Ex Parte* presentation at 16.

modulation technologies.³¹⁴ Given the sensitivity of SDARS receivers, we conclude that it is appropriate to account for any resulting increased risk of overload interference to SDARS operations by limiting the base station average power level in WCS Blocks A and B.³¹⁵ Specifically, we find that it is appropriate to modify the WCS Block A and B base station limit to 2-kW average EIRP over 5 megahertz (400 W/MHz) with a PAPR of 13 dB when measured at the 0.1-percent probability level.³¹⁶ This approach should provide the technical flexibility for WCS licensees in these blocks to feasibly deploy mobile broadband services to the public with minimal impact on SDARS users.

132. We agree with commenters who state that applying an average power approach would be beneficial in situations where wideband non-constant envelope technologies are used. The Commission permits licensees in other wireless services flexibility to meet radiated power limits on an average basis.³¹⁷ In other proceedings, the Commission noted that a number of the newer non-constant envelope technologies, such as OFDM-based technologies, can produce an emission with transient power spikes.³¹⁸ The Commission concluded that limiting power on an average basis would more accurately predict the interference potential for such technologies, and that using peak power measurements for non-constant envelope technologies inaccurately suggests a much higher overall operational power, compared to actual power levels, due to the power spikes.³¹⁹ Because average power is a more accurate measure of interference potential with respect to technologies that are likely to be deployed in the WCS spectrum, we conclude that we should adopt this mode of operation for the WCS A and B blocks.

133. In addition, we conclude that the use of a PAPR of 13 dB will provide an additional flexibility to WCS licensees without causing greater risk of interference to SDARS operations. The Commission found in other proceedings that limiting that PAPR to 13 dB strikes the right balance “between enabling licenses to use modulation schemes with high PAPRs (such as OFDM) and protecting other licensees from high PAPR transmissions.”³²⁰ Further, commenters agree that the use of a

³¹⁴ Non-constant envelope modulation, as used in wideband Code Division Multiple Access (W-CDMA) networks, is characterized by high PAPRs and requires both the phase and the amplitude of the signal to be modulated, as opposed to constant envelope modulation, as used in GSM networks, which only involves the phase.

³¹⁵ Based on the mobile receiver overload parameters (-44 dBm in the WCS A and B blocks, and -55 dBm in the WCS C and D blocks) submitted by Sirius (Sirius Comments, Exhibit C.) and the WCS Coalition (WCS Coalition Comments at 15), we illustrate a horizontal separation needed to avoid overload interference caused to an SDARS receiver from a WCS base station. Assuming a WCS base station height of 30 meters (approximate height for cellular-type architectures), with peak EIRP of 8 kW (2 kW per 1.25 megahertz-wide emissions, with 4 carriers in a 5 megahertz block), as currently allowed under Section 27.50(a)(1), an SDARS receiver overload level of -55dBm, an SDARS receiver height of 1.5 meters, flat terrain, and an empirical path loss model suitable for an urban area under these conditions, namely COST-231 Hata Model, the separation distance for the WCS C or D block would be 347 meters if the current peak power limit for the WCS C and D blocks were to be retained. Using the -44 dBm overload threshold agreed upon by the parties for the A and B blocks, we find that permitting an average EIRP of 2 kW over a 5-megahertz bandwidth (or 400 W/MHz) in the WCS A and B blocks will result in a separation distance of less than 347 meters.

³¹⁶ In radio networks, the PAPR is measured at a particular probability level to restrict how often the peak power is above the specified average power level.

³¹⁷ See *Streamlining Third Report and Order*, 23 FCC Rcd 5336-5337 ¶¶ 40-42; *700 MHz Report and Order*, 22 FCC Rcd at 15417-18.

³¹⁸ See *Streamlining Third Report and Order*, 23 FCC Rcd at 5334 ¶ 34.

³¹⁹ See *id.* at 5337 ¶ 40.

³²⁰ See *700 MHz Report and Order*, 22 FCC Rcd at 8104 ¶ 39; *Streamlining Third Report and Order*, 23 FCC Rcd at 5337 ¶ 42.

13-dB PAPR will provide technical flexibility, and maintain consistency with other services.³²¹ We believe that the application of a 13-dB PAPR limit in this matter furthers the Commission's goal of facilitating the deployment of advanced technologies, while limiting the potential for interference that might result from high PAPR transmissions.

134. We believe that, in light of the sensitivity of SDARS receivers to overload interference, it is in the public interest to apply a power spectral density formulation as proposed by the WCS Coalition.³²² We conclude that in WCS Blocks A and B, specifying the bandwidth over which power is to be limited is appropriate because it could otherwise be assumed that the power limit applies on a "per emission" basis. For example, a licensee employing one variation of WiMAX might only transmit one emission within its five-megahertz bandwidth, while another variation of WiMAX or other technologies with narrower emissions might employ multiple emissions over that bandwidth, each at the maximum power level allowed. Such a result would increase the likelihood of interference to SDARS receivers. Accordingly, the power limit for WCS base stations operations in Blocks A and B will be expressed as average EIRP of 2,000 W (2 kW) over a 5-megahertz bandwidth (400 W/MHz), with a 13-dB PAPR.³²³ To further limit the potential for interference to SDARS receivers, WCS base stations supporting FDD mobile and portable operations are restricted to transmitting in the 2345-2360 MHz band.

3. WCS Base and Fixed Station Out-of-Band Emissions Limit

135. We also find that the public interest would be served by adopting an OOB attenuation factor for WCS base and fixed stations below the transmitter power P, as measured over a 1-megahertz resolution bandwidth, of not less than $43 + 10 \log(P)$ dB on all frequencies between 2305-2320 MHz and between 2345-2360 MHz that are outside the licensed band of operation, not less than $75 + 10 \log(P)$ dB in the 2320-2345 MHz band, not less than $43 + 10 \log(P)$ dB in the 2300-2305 and 2360-2362.5 MHz bands, not less than $55 + 10 \log(P)$ dB in the 2362.5-2365 MHz band, not less than $70 + 10 \log(P)$ dB in the 2287.5-2300 MHz and 2365-2367.5 MHz bands, not less than $72 + 10 \log(P)$ dB in the 2285-2287.5 and 2367.5-2370 MHz bands, and not less than $75 + 10 \log(P)$ dB below 2285 MHz and above 2370 MHz.

136. As noted above, both WCS and SDARS licensees urge us to lower the current $80 + 10 \log(P)$ dB OOB attenuation factor by 5 dB to $75 + 10 \log(P)$ dB. Although the SDARS licensees also request that we establish ground-level emission limits, we decline to adopt ground-level emission limits for WCS base stations as proposed by Sirius XM because of the difficulties associated with characterizing and quantifying the case-specific propagation environment's effects on an RF signal's field strength that could influence the interference potential at each fixed site. The rules that would result from an attempt to deal with the anomalies associated with field strength levels, moreover, would be overly complex and difficult for licensees to comply with and would be difficult, at best, for the Commission to enforce. Furthermore, we believe that the revised power limits that we are establishing, together with a $75 + 10 \log(P)$ dB OOB attenuation factor, will provide SDARS operations reasonable interference protection while affording WCS licensees additional flexibility to offer mobile services to the public. We therefore are revising Section 27.53 of our rules to reflect the relaxed OOB attenuation requirements outlined above. Below in Section F, we will discuss the impact of these emission limits on the sharing environment relative to AMT and DSN operations.

³²¹ Motorola Comments at 5; WCS Coalition Reply Comments at 54-55.

³²² See, e.g., WCS Coalition Reply Comments at 41-44; WCS Coalition July 22, 2008, *Ex Parte* Exhibit A.

³²³ The peak-to-average power ratio (PAPR) measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that the PAPR will not exceed 13 dB for more than 0.1 percent of the time or another Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

4. WCS Customer Premises Equipment

137. *Background.* The WCS Coalition proposes that WCS fixed CPE devices be limited to an average EIRP of 20 W, with the average EIRP calculated by using the average power of the transmitter measured in accordance with the definition of mean power in Section 2.1 of the Commission's Rules.³²⁴ The WCS Coalition also proposes attenuating the OOB E for such CPE devices by a factor not less than $75 + 10 \log (P)$ dB below the transmitter output power P on all frequencies in the 2320-2345 MHz band. Alternatively, for WCS fixed CPE devices transmitting at no greater than 2 W average transmitter output power, the WCS Coalition proposes that the OOB E be attenuated by a factor of $55 + 10 \log (P)$ dB on all frequencies in the 2320-2324 and 2341-2345 MHz bands, by a factor of $61 + 10 \log (P)$ dB for frequencies in the 2324-2328 and 2337-2341 MHz bands, and by a factor of $67 + 10 \log (P)$ dB for frequencies in the 2328-2337 MHz band. In other words, the WCS Coalition believes that the stepped OOB E mask of 55/61/67 + 10 log (P) dB that it proposes for WCS mobile and portable devices should also apply to WCS CPE transmitting at 2 W or less.

138. Regarding the frequencies above and below the WCS band, originally, the WCS Coalition proposed that WCS fixed CPE devices' OOB E be attenuated by a factor of $70 + 10 \log (P)$ dB for all frequencies below 2300 MHz and above 2370 MHz. For all frequencies in the 2300-2320 and 2345-2370 MHz bands that are outside the licensed bands of operation, the WCS Coalition proposed that WCS fixed CPE devices OOB E be attenuated by $43 + 10 \log (P)$ dB. In addition, the WCS Coalition proposes that in complying with its proposed OOB E limits, WCS fixed CPE devices that use opposite sense circular polarization from that used by SDARS systems in the 2320-2345 MHz band shall be permitted an OOB E allowance of 10 dB.³²⁵ However, on March 15, 2010, the WCS Coalition submitted an *ex parte* presentation amending their proposal for CPE OOB E limits. Specifically, they now propose that WCS fixed stations be attenuated by $43 + 10 \log (P)$ dB on all frequencies between 2305-2320 MHz and on all frequencies between 2345-2360 MHz that are outside the licensed band of operation, not less than $55 + 10 \log (P)$ dB at 2362.5 MHz, not less than $70 + 10 \log (P)$ dB at 2300 and 2365 MHz, not less than $72 + 10 \log (P)$ dB at 2367.5 MHz, and not less than $75 + 10 \log (P)$ dB at 2370 MHz.³²⁶

139. Sirius XM, on the other hand, proposes that all WCS fixed CPE devices' OOB E outside the 2305-2320 and 2345-2360 MHz bands be attenuated by $75 + 10 \log (P)$ dB over a 1-megahertz resolution bandwidth, regardless of the device's operating power.³²⁷ Sirius XM also proposes that WCS fixed CPE devices operating with an EIRP greater than 2 W be subject to ground level-based emission limits of $100 \text{ dB}\mu\text{V/m}$ (-44 dBm isotropic equivalent power) for the WCS A and B blocks (2305-2315 and 2350-2360 MHz) and $90 \text{ dB}\mu\text{V/m}$ (-55 dBm isotropic equivalent power) for the WCS C and D blocks (2315-2320 and 2345-2350 MHz).³²⁸ In addition, Sirius XM proposes that WCS fixed CPE devices operating at 2 W EIRP or less be exempt from the ground level-based emission limits requirements, so long as they also meet the $75 + 10 \log (P)$ dB OOB E attenuation requirement.³²⁹ In its comments on the Commission staff's proposed interference rules, Sirius XM reiterated its position on CPE devices. It added however, that, at a minimum, the required OOB E attenuation for fixed CPE devices should be

³²⁴ In the Commission's Rules, mean power (of a radio transmitter) is defined as the average power supplied to the antenna transmission line by a transmitter during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation taken under normal operating conditions. See 47 C.F.R. § 2.1.

³²⁵ WCS Coalition July 22, 2008, *Ex Parte*, Exhibit A at 1-2.

³²⁶ See WCS Coalition March 15, 2010, *Ex Parte*, at 8.

³²⁷ Sirius Comments, Exhibit A at 4.

³²⁸ Sirius Comments, Exhibit A at 13.

³²⁹ *Id.* See also Sirius Comments at 31-32.

maintained at the existing $80 + 10 \log P$ dB level on all frequencies between 2320-2345 MHz.³³⁰ Sirius XM also expressed concern about there not being any prohibition on the use of external antennas with WCS CPE or on outdoor CPE installations. In addition, Sirius XM stated that the Commission should apply the proposed WCS 2.5-megahertz mobile and portable device guard band to CPE devices by prohibiting the operation of WCS CPE in the 2.5 megahertz closest to the SDARS band.³³¹

140. *Discussion.* Although we are establishing guard bands for the 2.5-megahertz portions of the WCS C and D Blocks immediately adjacent to the SDARS band because this portion of spectrum is currently not viable for full power mobile and portable device operations in close proximity to an SDARS receiver,³³² we believe that this spectrum can still play an important role in providing broadband service to the public. Because of the likely physical separation of a fixed WCS transmitter from an SDARS receiver, we expect WCS licensees will be able to use these portions of the WCS C and D Blocks to provide fixed operations, including CPE and backhaul operations, with little impact on SDARS reception. Thus, we decide that we should adopt the current mobile transmitter power limit of 20 watts per 5-megahertz peak EIRP for WCS fixed CPE devices.³³³ WCS CPE devices should also employ ATPC, so the transmitted power is limited to the maximum necessary for successful communications. For fixed customer premises equipment (CPE) transmitting with more than 2-W per 5-megahertz average EIRP, we also decide to adopt the OOB attenuation factors that we are adopting for WCS base stations of not less than $43 + 10 \log (P)$ dB on all frequencies between 2305-2320 MHz and on all frequencies between 2345-2360 MHz that are outside the licensed band of operation, and not less than $75 + 10 \log (P)$ dB on all frequencies between 2320 and 2345 MHz. These WCS CPE's OOB must also be attenuated by a factor of not less than $43 + 10 \log P$ dB at 2305 and 2360 MHz, $55 + 10 \log P$ dB at 2362.5 MHz, $70 + 10 \log P$ dB at 2300 and 2365 MHz, $72 + 10 \log P$ dB at 2287.5 and 2367.5 MHz, and $75 + 10 \log P$ dB below 2285 MHz and above 2370 MHz.

141. An examination of the Commission's Equipment Authorization Database shows that although most 2.3 GHz WCS fixed CPE devices are authorized to use significantly lower EIRP levels (e.g., in the 1 to 2 W range), some WCS fixed CPE devices are authorized to operate up to the 20-W EIRP currently allowed for WCS mobile devices.³³⁴ Authorized WCS fixed CPE devices have been operating at EIRPs up to 20 W for some time in the 2.3 GHz band, but SDARS licensees have not reported any instances of interference. We expect that if we were to continue to allow WCS fixed CPE devices to use up to 20 W per 5-megahertz peak EIRP, SDARS operations would not experience any appreciable increase in interference from these WCS operations. Moreover, continuing to allow WCS fixed CPE devices to use up to 20 W per 5-megahertz EIRP will enhance the provision and quality of service in rural areas, where subscribers are often located significant distances from WCS licensees' serving base stations. Furthermore, as discussed in paragraph 136, *supra*, we decline to adopt the ground level-emission limits proposal of Sirius because of the difficulties associated with characterizing and quantifying the case-specific propagation environment's effects on an RF signal's field strength that could influence the interference potential at each fixed site.

142. In a fixed scenario, there exists an increased separation distance between WCS CPE and SDARS receivers than would exist in a vehicle-to-vehicle scenario. Furthermore, structural blockages are

³³⁰ See Comments of Sirius XM, filed April 23, 2010, at 34-35.

³³¹ *Id.*

³³² Based on the results of the Ashburn, VA tests, to prevent SDARS receivers from receiving harmful interference, WCS mobile and portable devices are prohibited from operating in the 2.5-megahertz portions of the WCS C and D blocks closest to the SDARS band (i.e., 2317.5-2320 and 2345-2347.5 MHz).

³³³ See 47 C.F.R. § 27.50(a)(2).

³³⁴ See, e.g., FCC Identifier AEZCPE-310-230.

more likely to exist between fixed WCS CPE devices and SDARS receivers. The increased propagation losses that result from these factors allow for greater flexibility in establishing technical limits for WCS fixed CPE devices operating at or below 2-W per 5-megahertz average EIRP. We therefore adopt the stepped OOB attenuation factors proposed by the WCS Coalition for mobile and portable devices' OOB into the SDARS band. Specifically, for fixed CPE transmitting with 2-W per 5-megahertz average EIRP or less, OOB emissions must be attenuated by a factor of $43 + 10 \log(P)$ dB on all frequencies between 2305-2320 MHz and on all frequencies between 2345-2360 MHz that are outside the licensed band of operation, not less than $55 + 10 \log(P)$ dB in the 2320-2324/2341-2345 MHz bands, not less than $61 + 10 \log(P)$ dB in the 2324-2328/2337-2341 MHz bands, not less than $67 + 10 \log(P)$ dB in the 2328-2337 MHz band, where P is the transmitter output power in Watts. To protect DSN operations at 2290-2300 MHz and AMT operations at 2360-2395 MHz, OOB of CPE transmitting at 2 W per 5-megahertz average EIRP or less must be attenuated by a factor of not less than $43 + 10 \log(P)$ dB 2305 and 2360 MHz, not less than $55 + 10 \log(P)$ dB at 2300 MHz band, not less than $61 + 10 \log(P)$ dB at 2296 MHz band, not less than $67 + 10 \log(P)$ dB at 2292 MHz, and not less than $70 + 10 \log(P)$ dB below 2288 MHz and above 2365 MHz.

143. We agree with the WCS Coalition that these emission limits – which we also adopt today for WCS mobile and portable devices – will provide reasonable protection to SDARS licensees, while affording much needed operational flexibility to WCS licensees.³³⁵ Although SDARS licensees oppose the stepped OOB limits and instead³³⁶ advocate a reduced OOB attenuation requirement of $75 + 10 \log(P)$ dB, the SDARS licensees note that current fixed WCS deployments pose no or little interference concerns to SDARS operations.³³⁷ In addition, the SDARS licensees recognize that WCS fixed CPE devices operating at or below 2 W per 5-megahertz average EIRP do not require the same safeguards against interference to SDARS operations as fixed stations transmitting at higher power levels.³³⁸ As we have concluded *supra* that the stepped OOB attenuation factors for WCS mobile and portable devices will provide sufficient protection to SDARS operations, we conclude that WCS CPE operating at 2 W per 5-megahertz average EIRP or less with these same attenuation factors will provide SDARS operations sufficient protection from harmful interference. Thus, we find that it is appropriate to adopt the stepped OOB attenuation factors for WCS fixed CPE operating at 2-W per 5-megahertz average EIRP or less that we are adopting for WCS mobile and portable devices. To further limit the potential for harmful interference from WCS CPE to SDARS receivers, however, we restrict WCS CPE devices operating at 2 Watts per 5-megahertz or less average EIRP to the use of indoor antennas and indoor installations. We also require WCS CPE to employ ATPC to limit their transmitted power to that which is necessary for successful communications. Because we believe the increased propagation losses associated with the increased distances between WCS CPE and SDARS receivers and structural blockages will be sufficient to limit the potential for harmful interference from WCS CPE, we will not, however, apply a 2.5-megahertz guard band to WCS CPE and prohibit their operation in the 2.5-megahertz portions of the WCS band closest to the SDARS band. For WCS CPE using TDD technology, we set the maximum duty cycle to 38 percent; for WCS CPE using FDD technology, we set the maximum duty cycle to 12.5 percent in the WCS C block (*i.e.*, 2315-2320 MHz) and to 25 percent in the lower WCS A and B blocks (*i.e.*, 2305-2315 MHz).

³³⁵ See WCS Coalition Comments at 11-12.

³³⁶ Sirius Comments at 31-32, XM Comments at 35, Exhibit A at 15.

³³⁷ XM Comments at 33, Exhibit A at 14.

³³⁸ Although the SDARS licensees argue that WCS fixed terminals/stations operating above 2 W should be subject to the $75 + 10 \log(P)$ dB OOB attenuation level as well as a ground-based power limit to protect SDARS operations, the SDARS licensees support exempting WCS fixed CPE devices operating at a lower power from a ground-based power limit. Sirius Comments at 31-32 (supporting an exemption so long as the WCS fixed CPE devices employ power control and a guard band for the C and D blocks), XM Comments at 35, Exhibit A at 15.

5. Notification Requirement

144. *Background.* In the *2001 Public Notice*, the Commission sought comment on whether to require WCS licensees to exchange information with SDARS licensees regarding WCS station deployments.³³⁹ This information would include the number of base stations, their locations and technical characteristics, and the estimated reasonable cost to resolve interference to any WCS station receiving blanketing interference from a specified SDARS repeater.³⁴⁰

145. In its *2006 Petition for Rulemaking*, Sirius proposed that we require both SDARS and WCS licensees to maintain certain information regarding their transmitter deployments, and to require that it be made available to other licensees via a secure Internet website.³⁴¹ Specifically, Sirius urged the Commission to require sharing of the following information: (1) a list of all operating transmitters and their technical parameters; (2) telephone and email address of emergency contacts to investigate complaints of harmful interference; and (3) the radiation patterns for all transmitting antenna types, including manufacturer name and model number.³⁴² Sirius also recommended that we require licensees to post a predictive analysis on the website, showing that a transmitter will meet the applicable power limits, no later than 90 days before it begins commercial operations.³⁴³

146. In the *2007 Notice*, we invited comment regarding the extent to which WCS licensees should be required to notify SDARS licensees of the deployments of base stations.³⁴⁴ We solicited comment on the proposals discussed above, and asked parties to discuss which proposal would provide the most effective and efficient means for parties to exchange information necessary to avoid interference and co-exist in adjacent spectrum.³⁴⁵ We specifically asked whether the Sirius website proposal is necessary to provide notice to all licensed radio stations potentially affected by WCS base station deployments, and whether the proposal should be considered only if we adopt Sirius' ground-level emission limits proposal.³⁴⁶

147. In response to the *2007 Notice*, Sirius reiterated its proposal to require all SDARS and WCS licensees to maintain an Internet-accessible database of all their deployed and planned repeater and base station operations, respectively, noting that such information could enable licensees to mitigate any out-of-band interference that they might experience.³⁴⁷ XM asserted that SDARS operators and WCS licensees can resolve interference issues between themselves in coordination.³⁴⁸ XM supported notification and record-keeping requirements to facilitate coordination, provided that the requirements are

³³⁹ *2001 Public Notice*, 16 FCC Rcd at 19441-42, cited in *2007 Notice*, 22 FCC Rcd at 22134 ¶ 30.

³⁴⁰ *Id.*

³⁴¹ *2006 Petition for Rulemaking* at 6, cited in *2007 Notice*, 22 FCC Rcd at 22134-35 ¶ 31.

³⁴² *2006 Petition for Rulemaking*, Appendix A, proposed Section 25.214(d)(6), and Appendix B, proposed Section 27.50(l), cited in *2007 Notice*, 22 FCC Rcd at 22134-35 ¶ 31.

³⁴³ *Id.* Sirius proposed that we exempt SDARS licensees from these requirements for repeaters operating with an EIRP of 10 W or less, and repeaters deployed before the date the rule would become effective. See *2006 Petition for Rulemaking*, Appendix A, proposed Section 25.214(d)(6), cited in *2007 Notice*, 22 FCC Rcd at 22134-35 ¶ 31.

³⁴⁴ *2007 Notice*, 22 FCC Rcd at 22135 ¶ 32.

³⁴⁵ *Id.*

³⁴⁶ *Id.*

³⁴⁷ Sirius Comments at 9-10.

³⁴⁸ XM Comments at 38-39.

narrowly tailored to minimize administrative burdens.³⁴⁹ XM also suggested that this information be maintained by a third-party frequency coordinator.³⁵⁰ In its comments on the Commission staff's proposed interference rules, Sirius XM argues that the revised WCS rules should also require WCS and satellite radio licensees to negotiate a coordination agreement governing WCS base station deployment, define harmful interference to satellite radio to mean "muting" of satellite radios, obligate WCS licensees to resolve harmful interference to satellite radio by immediately ceasing operations, establish an expedited procedure for FCC adjudication in the event of disputes, and, in any event, should impose significant penalties on WCS licensees who cause interference to satellite radio. Sirius XM contends that including such requirements in the WCS rules would ensure that future WCS licensees are fully aware of their obligations to satellite radio.³⁵¹

148. While the WCS Coalition generally supported measures that encourage SDARS and WCS licensees to share certain technical information, it argued that requiring the provision of such information 90 days before operating a new facility would be unduly burdensome. According to the WCS Coalition, WCS licensees will need to adjust their base stations frequently to provide optimal coverage to the public, and a 90-day notice requirement would severely impede that process.³⁵² The WCS Coalition argues further that there is no reason to require such reporting unless the Commission assumes that there will be a problem with complying with the rules.³⁵³ Sirius responds that both SDARS and WCS licensees would be subject to its proposed 90-day notice requirement, and questioned why the WCS Coalition would oppose the proposal while advocating coordination of repeaters exceeding 2-kW average EIRP limit.³⁵⁴

149. In its comments on the Commission staff's proposed interference rules, the WCS Coalition states that although it supports the 10-day notification period for new WCS base stations, it believes the requirement to give 5 days notice before modifications are made to existing WCS base stations is problematic, given the manner in which ubiquitous cellular networks are constantly being adjusted to assure consumers the best quality of service. As an alternative, the WCS Coalition proposes that notice of any modification to a WCS base station, other than a change in location, be given within 24 hours of the modification being made. The WCS Coalition contends that this approach would assure that SDARS licensees have current data regarding the configuration of WCS facilities and would facilitate future cooperation between WCS and SDARS licensees, but would allow modifications not related to locations to be made within the timeframes dictated by marketplace realities.³⁵⁵ Sirius XM, on the other hand, states that the 10-day and 5-day notice periods in the *WCS/SDARS Technical Rules Public Notice* are insufficient.³⁵⁶ It claims that 10 days is too short to review and process information about a potentially large number of new base station sites and to raise concerns about potential interference.³⁵⁷ Sirius XM also asserts that more specific processes are needed to define and assess interference, to respond to interference claims, and to resolve interference complaints that the parties cannot resolve

³⁴⁹ *Id.* at 39.

³⁵⁰ *Id.*

³⁵¹ See Comments of Sirius XM, filed April 23, 2010, at 32-34.

³⁵² WCS Coalition Comments at 38-40.

³⁵³ *Id.* at 40.

³⁵⁴ Sirius Reply at 34-35.

³⁵⁵ *Id.* at 14-16.

³⁵⁶ Comments of Sirius XM Radio Inc. at 2 (filed May 13, 2010).

³⁵⁷ *Id.*

themselves.³⁵⁸ In particular, it calls for at least 180-days notice prior to any WCS base station offering service to the public.³⁵⁹ In response to this proposal, the WCS Coalition argues that if WCS licensees are required to give 180 days advance notice prior to deploying new base stations, they will be incapable of responding within the time frames demanded by the marketplace, particularly as dead zones within existing markets are identified.³⁶⁰ In addition, the WCS Coalition contends that such a requirement for WCS licensees would hardly be fair and balanced given that Sirius XM has proposed that it be exempt from providing any advance notification of the location of its terrestrial repeaters.³⁶¹

150. *Discussion.* Based on the record before us, we find that the public interest will be served by requiring WCS licensees to notify SDARS licensees prior to deploying new or modified base stations. We note that all parties addressing this issue support requiring coordination in some form. The notification requirements that we adopt below are intended to enable SDARS licensees to minimize the potential for harmful interference to their services without imposing undue administrative burden, while ensuring that the public continues to enjoy those services without disruption. We decline, however, to adopt Sirius' 2006 proposal that would require 90-day prior coordination. We agree with the WCS Coalition that a 90-day notice requirement is unnecessary, and with XM's assertion that any notification requirements should be designed to minimize administrative burdens for licensees.

151. Our review of the record indicates that the potential for interference between WCS and SDARS can be mitigated by a streamlined notification process, whereby WCS licensees share information regarding new or modified WCS base station operations. Specifically, we will require WCS licensees to provide informational notifications as specified in those rules, as set forth in new Section 27.72 in Appendix B.³⁶² The rules we adopt today will require WCS licensees to share with SDARS licensees certain technical information at least 10 business days before operating a new base station, and at least 5 business days before operating a modified base station. We also will require all WCS licensees and WCS spectrum lessees to provide Sirius XM an inventory of their deployed infrastructure in accordance with and within 30 days of the effective date of new Section 27.72 in Appendix B to this Order. Although we do not require this information to be provided to the Commission when it is provided to SDARS licensees, a WCS licensee must maintain an accurate and up-to-date inventory of its base stations, including the information set forth in Section 27.72(c)(2), which shall be made available upon request by the Commission.³⁶³

152. We also find that the public interest will be served by requiring parties to cooperate in good faith in the selection and use of station sites and frequencies to reduce interference and make the most effective use of the authorized facilities. Licensees of stations suffering or causing harmful interference must cooperate in good faith and resolve such problems by mutually satisfactory arrangements. If the licensees are unable to do so, the Wireless Telecommunications Bureau, in consultation with the Office of Engineering and Technology and the International Bureau, may impose restrictions on WCS licensees, including specifying the transmitter power, antenna height, or area or hours of operation of the stations. Similarly, the International Bureau, in consultation with the Wireless

³⁵⁸ *Id.*

³⁵⁹ *Id.*, Attachment at 1.

³⁶⁰ See WCS Coalition *Ex Parte* presentation, filed May 13, 2010, at 3.

³⁶¹ *Id.*

³⁶² We note that if a WCS licensee is party to a *de facto* transfer spectrum leasing arrangement under Part 1, Subpart X of the Commission's rules, its lessee will be required to comply with new Section 27.72, in Appendix B to this Order.

³⁶³ See *infra*, Appendix B, at § 27.72(c)(3).

Telecommunications Bureau and the Office of Engineering and Technology, may impose such restrictions on SDARS licensees. We note that Sirius XM proposed specific metrics for defining harmful interference and crafted a comprehensive process for exchanging information among the licenses, analyzing the potential for harmful interference and specific steps for remedying harmful interference.³⁶⁴ Although we do not adopt these specific proposals in Part 25 or Part 27 of our Rules, we refer Commission staff to the comments for consideration in resolving interference issues as they arise.

153. We note that in today's companion *Second Report and Order* in IB Docket 95-91, we are requiring SDARS licensees to provide WCS licensees an inventory of their already-deployed terrestrial-repeater infrastructure.³⁶⁵ Provision of this information will provide WCS licensees a baseline from which to plan their network deployments. In the companion order, we also are adopting streamlined notification procedures that are designed to help ensure that new or modified SDARS terrestrial repeaters will not cause harmful interference to existing WCS base stations, and to facilitate future WCS network deployments. Specifically, the new rules will require SDARS licensees to provide WCS licensees certain technical information prior to deploying new or modifying existing repeaters.³⁶⁶

6. Legal Issues Raised by Sirius XM

154. Sirius XM alleges that adoption of WCS rules as proposed in the WCS/SDARS Technical Rules Public Notice and the resulting interference will improperly modify its licenses, and limit Sirius XM's utilization of its licensed spectrum in violation of its statutory, constitutional, and contractual rights. At the outset, we continue to reject Sirius XM's assertion that the changes to the WCS technical rules will necessarily result in harmful interference to SDARS operations. The rule changes that we are adopting to enable the provision of mobile broadband services in the 2.3 GHz band are tailored to avoid harmful interference to SDARS operations, and, as a result, will not hamper Sirius XM's ability to utilize its spectrum. Moreover, as explained below, we find that Sirius XM's legal arguments lack merit.

155. *Section 316 Modification.* Sirius XM asserts that any Commission action allowing additional interference to a licensee constitutes a modification of license under Section 316 of the Communications Act.³⁶⁷ Sirius XM states that, because the proposed rules "reverse" the Commission's current OOB protections and will cause significant interference to Sirius XM's operations, the proposed rules constitute a modification of Sirius XM's licenses under Section 316, and thus Sirius XM is entitled to that section's procedural protections, including an adjudicatory hearing.³⁶⁸

156. Section 316 of the Act provides for an adjudication process before the Commission may modify a particular license.³⁶⁹ That provision, however, does not deprive the Commission of its authority to establish rules of general applicability to an industry through its notice-and-comment rulemaking authority.³⁷⁰ Sirius XM acknowledges that the Commission may adopt rules of general applicability that

³⁶⁴ See Sirius XM *Ex Parte* Communication, filed May 13, 2010, Attachment at 1-2.

³⁶⁵ See *infra* ¶ 278.

³⁶⁶ See § 25.263 in Appendix B to this Order.

³⁶⁷ Sirius 4.23 Comments at 49.

³⁶⁸ *Id.* at 50-51.

³⁶⁹ 47 U.S.C. § 316.

³⁷⁰ See *Committee for Effective Cellular Rules v. FCC*, 53 F.3d 1309 (D.C.Cir. 1995); *Upjohn Co. v. FDA*, 811 F.2d 1583 (D.C. Cir. 1987); *WBEN, Inc. v. FCC*, 396 F.2d 601, 618 (2d Cir.), cert. denied, 393 U.S. 914 (1968) (stating that "[a]djudicatory hearings serve an important function when the agency bases its decision on the peculiar situation of individual parties who know more than anyone else. But when, as here, a new policy is based upon the general characteristics of an industry, rational decision is not furthered by requiring the agency to lose itself in an

affect a class of licensees, but states that the Commission must conduct a Section 316 adjudication when an individual licensee's interests are at stake.³⁷¹ Sirius XM argues that the proposed rules do not directly apply to a broad class of licensees, but affect only Sirius XM.³⁷² While Sirius XM is correct that it is the only entity holding SDARS licenses involved in this proceeding, it neglects to note that it constitutes the entire class of SDARS licensees. To the extent that the revised WCS technical rules have any effect on SDARS rights, such effect is applicable to all current or future SDARS licensees. We therefore reject as unfounded Sirius XM's argument that our actions are directed solely to the licenses of an individual licensee. As explained above, the purpose of the Commission's actions here is to establish revised technical rules that will foster the provision of new services without causing harmful interference among a number of adjacent services, including SDARS, WCS, and AMT. Thus, our new rules are based on the general characteristics of a number of services, and adjudicatory hearings concerning the impact on Sirius XM would be inappropriate.

157. *Retroactivity.* Sirius XM also asserts that the proposed rules would improperly result in both primary and secondary retroactive changes to satellite radio licenses Sirius and XM acquired at auction.³⁷³ Sirius XM argues that the proposed rules would have primary retroactive effect because they "significantly impair" the rights provided by Sirius XM's licenses.³⁷⁴ It is unclear, however, how adoption of the proposed technical rules would constitute primary retroactivity. Primary or direct retroactive application of a rule is limited to situations in which an agency "alter[s] the *past* legal consequences of past actions."³⁷⁵ Application of a rule is impermissibly retroactive when it "would impair rights a party possessed when he acted, increase a party's liability for past conduct, or impose new duties with respect to transactions already completed."³⁷⁶ In contrast, application of the revised WCS technical rules would have a prospective effect only. Even if the revised technical rules somehow affects Sirius XM's operations or planned use of its spectrum going forward, Commission action that upsets expectations held by Sirius XM based on existing rules is not impermissibly retroactive.³⁷⁷ Moreover,

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 excursion into detail that too often obscures fundamental issues rather than clarifies them"); Revision of Part 22 and Part 90 of the Commission's Rules to Facilitate Future Development of Paging Systems, WT Docket No. 96-18, Implementation of Section 309(J) of the Communications Act -- Competitive Bidding, PR Docket No. 93-253, *Memorandum Opinion and Order on Reconsideration and Third Report and Order*, 14 FCC Rcd 10030, 10096 ¶ 123 (1999) (*Paging MO&O on Reconsideration and Third R&O*); Amendment of Part 22 of the Commission's Rules to Provide for Filing and Processing of Applications for Unserved Areas in the Cellular Service and to Modify Other Cellular Rules, *Further Memorandum and Opinion on Reconsideration*, 12 FCC Rcd 2109, 2127-28, ¶ 37 (1997); and Revision of Rules and Policies for the Direct Broadcast Satellite Service, *Report and Order*, 11 FCC Rcd 9712, 9766, ¶ 139 (1995) (stating that "the Commission may modify any station license or construction permit if in its judgment such action will promote the public interest, convenience, and necessity, and, ... such modification may appropriately be accomplished through notice and comment rulemaking").

³⁷¹ Sirius 4.23 Comments at 50-51.

³⁷² *Id.* at 52.

³⁷³ Sirius 4.23 Comments at 53-54.

³⁷⁴ *Id.* at 54.

³⁷⁵ See *Celotronic Telemetry, Inc. v. FCC*, 272 F.3d 585, 588 (D.C. Cir. 2001) (citing *Bowen v. Georgetown University Hospital*, 488 U.S. 204, 219 (Scalia, J., concurring)).

³⁷⁶ *Celotronic Telemetry, Inc.*, 272 F.3d at 588 (citing *Landgraf v. USI Film Products*, 511 U.S. 244, 280 (1994)).

³⁷⁷ See *National Cable & Telecommunications Assn. v. FCC*, 567 F.3d 659, 670 (D.C. Cir. 2009) (citing *Mobile Relay Assocs. v. FCC*, 457 F.3d 1, 11 (D.C. Cir. 2006)); *Chemical Manufacturers Ass'n v. EPA*, 869 F.2d 1526, 1536 (D.C. Cir. 1989) (stating that "[i]t is often the case that a business will undertake a certain course of conduct based on the current law, and will then find its expectations frustrated when the law changes. This has never been thought to constitute retroactive rulemaking, and indeed most economic regulation would be unworkable if all laws disrupting prior expectations were deemed suspect").

Sirius XM could not have had any reasonable expectation that the Commission would refrain from exercising its regulatory power to change the operational requirements of a service in cases where the public interest is best served by such change, given that the Communications Act prohibits the grant of any license without a waiver by the licensee in the use of the spectrum “as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise.”³⁷⁸ Similarly, Sirius XM’s argument conflicts with an underlying policy of the Act, discussed below, that no person is to have anything in the nature of a property right as a result of the granting of a license.

158. We also reject Sirius XM’s claim that the revision of the WCS technical rules will have harmful, secondarily retroactive effects. Sirius XM argues that the proposed rules may result in secondary retroactivity because bidders relied on Commission rules protecting SDARS spectrum from interference from mobile WCS operations, and spent billions of dollars to deploy satellite networks and equipment based on rules in existence when they purchased their licenses.³⁷⁹ An agency must balance harmful “secondary retroactivity” of an action that upsets prior expectations or existing investments against the benefits of applying rules to those preexisting interests.³⁸⁰ Secondary retroactivity will be upheld if it is reasonable.³⁸¹ As discussed above, we reject Sirius XM’s premise that changes to the WCS technical rules will result in harmful interference, so the effect on Sirius XM’s investment or Sirius XM’s use of its licensed spectrum does not rise to the level of harmful secondary retroactivity. In any event, even if there is harmful secondary retroactivity, we find that the rules we adopt here reasonably balance the public interest in establishing revised technical limits to facilitate the provision of mobile broadband services and Sirius XM’s interest in maintenance of the status quo.

159. *Fifth Amendment Taking.* Sirius XM further argues that interference resulting from the relaxation of OOB limits likely constitutes a taking in violation of the Fifth Amendment.³⁸² It asserts that government regulation that burdens property in a manner that unfairly interferes with the owner’s investment backed expectations constitutes a regulatory taking.³⁸³ For it to prevail on this takings claim, however, Sirius XM must show that it has a protected property interest in the spectrum licensed to it. However, the Communications Act is clear that there can be no ownership interest in the spectrum licensed to Sirius XM.³⁸⁴ The courts have long held that “[t]he policy of the Act is clear that no person is to have anything in the nature of a property right as a result of the granting of a license,”³⁸⁵ and that “[n]o licensee obtains any vested interest in any frequency.”³⁸⁶ The Commission has previously upheld this

³⁷⁸ 47 U.S.C. § 304.

³⁷⁹ Sirius 4.23 Comments at 54.

³⁸⁰ See *National Cable & Telecommunications Assn.*, 567 F.3d at 670 (citing *Bergerco Canada v. U.S. Treasury Dep’t*, 129 F.3d 189, 192-93 (D.C.Cir.1997)); *Mobile Relay Assocs.*, 457 F.3d at 11.

³⁸¹ *Mobile Relay Assocs.*, 457 F.3d at 11.

³⁸² Sirius 4.23 Comments at 56-57.

³⁸³ *Id.* at 57.

³⁸⁴ See, e.g., 47 U.S.C. § 301 (providing that it is the purpose of the Communications Act “to provide for the use of . . . channels [of radio transmission], but not the ownership thereof, by persons for limited periods of time, under licenses granted by Federal authority, and no such license shall be construed to create any right, beyond the terms, conditions, and periods of the license”); 47 U.S.C. § 304 (indicating that “[n]o station license shall be granted by the Commission until the applicant therefore shall have waived any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise”).

³⁸⁵ *FCC v. Sanders Bros. Radio Station*, 309 U.S. 470, 475, 60 S. Ct. 693, 697, 84 L. Ed. 869 (1940).

³⁸⁶ *Ashbacker Radio Corp. v. FCC*, 326 U.S. 327, 331, 66 S. Ct. 148, 150, 90 L. Ed. 108 (1945). See also *Mobile Relay Associates v. FCC*, 457 F.3d at 12 (holding that licenses confer only “the right to use the spectrum for a

(continued...)

principle,³⁸⁷ as well as rejected the argument that a post-auction rulemaking change that may affect the value of an auctioned license should be considered a taking under the Fifth Amendment.³⁸⁸ Accordingly, Sirius XM does not have a property interest in the spectrum covered by its SDARS licenses such that any rule change that might affect the licenses could be considered a Fifth Amendment taking of Sirius XM's property.

160. *Contractual Rights.* Finally, Sirius XM argues that adopting the proposed rules may breach the "existing contractual relationship" established when the Commission granted satellite radio licenses to Sirius and XM. Sirius XM argues that spectrum auctions create binding contracts between the Government and the winning bidder.³⁸⁹ Sirius XM argues that revising the WCS rules to allow harmful interference and thereby reducing the value of Sirius XM's licenses would breach the contract established at the spectrum auction.³⁹⁰ However, the Commission has previously rejected the notion that rule changes affecting a licensee constitutes a breach of the license contract.³⁹¹ It is well established that the Commission retains the power to alter the terms and conditions of existing licenses by rule making.³⁹² Further, the Communications Act makes clear that the auction mechanism for assigning licenses was not intended to change the Commission's basic regulatory role or otherwise provide additional rights to auction-winning licensees.³⁹³ Thus, no auction bidder, including Sirius or XM, could have assumed that it was buying a license containing terms that the Commission could not revise.

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duration expressly limited by statute subject to the Commission's considerable regulatory power and authority" and "[t]his right does not constitute a property interest protected by the Fifth Amendment."

³⁸⁷ See e.g. Amendment of Parts 73 and 74 of the Commission's Rules to Establish Rules for Digital Low Power Television, Television Translator, and Television Booster Stations and to Amend Rules for Digital Class A Stations, MB Docket No. 03-185, *Report and Order*, 19 FCC Rcd 19331, 19359 n.166 (2004); Allocations and Service Rules for the 71-76 GHz, 81-86 GHz and 92-95 GHz Bands, WT Docket No. 02-146, *Report and Order*, 18 FCC Rcd 23318, 23346 n.184 (2003); *Paging MO&O on Reconsideration and Third R&O*, 14 FCC Rcd at 10095-96 (1999).

³⁸⁸ See Amendment of the Commission's Rules Regarding Maritime Automatic Identification Systems, WT Docket No. 04-344, Petition for Rule Making Filed by National Telecommunications and Information Administration, RM-10821, Emergency Petition for Declaratory Ruling Filed by MariTEL, Amendment of the Commission's Rules Concerning Maritime Communications, PR Docket No. 92-257, *Report and Order and Further Notice of Proposed Rule Making and Fourth Memorandum Opinion and Order*, 21 FCC Rcd 8892, 8926-27 ¶ 46 (2006); Facilitating the Provision of Spectrum-Based Services to Rural Areas and Promoting Opportunities for Rural Telephone Companies to Provide Spectrum-Based Services, *Report and Order and Further Notice of Proposed Rule Making*, WT Docket No. 02-281, 19 FCC Rcd 19078, 19126 ¶ 84 (2004) (*Rural Report and Order*).

³⁸⁹ Sirius 4.23 Comments at 54-56.

³⁹⁰ *Id.* at 55-56.

³⁹¹ *Rural Report and Order*, 19 FCC Rcd at 19126 ¶ 84.

³⁹² See, e.g., *United States v. Storer Broadcasting*, 351 U.S. 192, 205 (1956); *Committee for Effective Cellular Rules v. FCC*, 53 F.3d at 1319-20.

³⁹³ See 47 U.S.C. §§ 309(j)(6)(C) (stating that nothing in the auction statute or use of auctions shall "diminish the authority of the Commission under the other provisions of [the Communications] Act to regulate or reclaim spectrum licenses"); cf. 47 U.S.C. § 309(j)(6)(D) (stating that nothing in the auction statute or in the use of auctions shall "be construed to convey any rights, including any expectation of renewal of a license, that differ from the rights that apply to other licenses within the same service that were not issued pursuant to this subsection").

F. Deep Space Network, Aeronautical Mobile Telemetry Service, and Amateur Service Operations

161. *Overview.* The 2360-2395 MHz band is allocated on a primary basis for Federal and non-Federal AMT use.³⁹⁴ The 2360-2390 MHz band is the part of the 2310-2390 MHz band that remained allocated for AMT after the 1992 World Administrative Radio Conference allocated spectrum to satellite audio broadcasting. The Commission allocated the spectrum 2320-2345 MHz on a primary basis to the SDARS and the 2305-2320 MHz and 2345-2360 MHz bands to the WCS thereby reducing the available spectrum for AMT in the United States in this band from 80 megahertz to 30 megahertz.³⁹⁵ In 2004, as a partial replacement for the spectrum that was allocated for the WCS and SDARS, the Commission allocated the 2390-2395 MHz band for AMT use, thereby increasing to 35 megahertz the amount of spectrum available for AMT.³⁹⁶

162. In allowing WCS licensees additional technical flexibility to facilitate the operation of mobile services, we must consider potential effects on other spectrum users above and below the WCS bands. Five megahertz below the 2305 MHz lower WCS band edge, in the 2290-2300 MHz band, NASA operates its Deep Space Network (DSN), which is vital for communications supporting space exploration. Additionally, above the 2360 MHz upper WCS band edge, AMT operations are conducted by Federal and non-Federal aviation entities in numerous areas throughout the country, collecting real-time data for the purposes of aircraft and missile flight testing. Also, in the 2300-2305 MHz band, immediately below the lower WCS band edge, radio amateurs conduct technical investigations using weak-signal operations. The Commission has also asked whether Medical Body Area Networks (MBANs) should be permitted to operate in the 2300-2305 MHz band.³⁹⁷

163. All of these services operate with highly sensitive receivers and high gain antennas in order to receive very weak signals. Although the weak signals and highly directional antennas could increase instances of interference, these services are also operated by persons with specialized technical expertise, and have different types of geographical deployments, so the interference considerations are somewhat different for these services, compared to those for the much more ubiquitous SDARS, which is used by consumers. The DSN is located at Goldstone in California's Mojave Desert. AMT receiving antennas are deployed in many areas that often have controlled boundaries, such as Federal and non-Federal facilities and airports. The number of amateur stations conducting weak signal operations in this band is relatively small, and they are often located in low-noise areas that provide favorable conditions for experimentation. As outlined below, we believe that reasonable rules can be devised to allow WCS mobile operations to commence without causing harmful interference to DSN, AMT, or amateur operations.

164. *Amateur and Deep Space Network (DSN) operations below the WCS bands.* Amateur station weak-signal operations in the 2300-2305 MHz band are clustered around 2304 MHz.³⁹⁸ Amateurs

³⁹⁴ 47 C.F.R. § 2.106, US276.

³⁹⁵ See Amendment of the Commission's Rules to Establish Part 27, the Wireless Communication Service, *Report and Order*, GN Docket No. 96-228, 12 FCC Rcd 3977 (1997).

³⁹⁶ See Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, Including Third Generation Wireless Systems, ET Docket No. 00-258, *Seventh Report and Order*, 19 FCC Rcd 21350, 21351 ¶ 3 (2004) (*AWS 7th R&O*).

³⁹⁷ See Amendment of the Commission's Rules to Provide Spectrum for the Operation of Medical Body Area Networks, ET Docket No. 08-59, *Notice of Proposed Rulemaking*, 24 FCC Rcd 9589 (2009).

³⁹⁸ The 2300-2305 MHz band is allocated to the amateur radio service on a secondary basis. There is no non-government primary allocation for this band.

use this frequency to experiment with home-built and adapted commercial microwave equipment and they employ special techniques to communicate across large distances. Some amateur stations operating in this band are designed to transmit signals that reflect off the surface of the moon and back to a receiving station on Earth. DSN operations are conducted in the 2290-2300 MHz band. The NASA DSN is an international network of antennas that support interplanetary spacecraft missions and radio and radar astronomy observations for exploration of the solar system and the universe. The DSN consists of three communications facilities spaced approximately 120 degrees of longitude apart around the world: at Goldstone, CA; near Madrid, Spain; and near Canberra, Australia. This strategic placement permits constant observation of spacecraft as the Earth rotates, and makes the DSN the largest and most sensitive scientific telecommunications system in the world.³⁹⁹

165. The comments are mostly silent on protection of the DSN and amateur operations below 2305 MHz. However, on May 4, 2010, the National Telecommunications and Information Administration (NTIA) submitted a letter to the record expressing concern that the DSN be protected from interference from WCS operations.⁴⁰⁰ NTIA proposes a relaxation of the WCS mobile/portable stations' OOB limits and a tightening of the WCS base stations' OOB limits (to account for equipment that is currently available) combined with an increase in the coordination distance for WCS base stations. Specifically, NTIA suggests that WCS base stations' OOB should be attenuated by a factor of not less than: $43 + 10 \log(P)$ dB in the 2300-2305 MHz band segment, $70 + 10 \log(P)$ dB in the 2287.5-2300 MHz band segment, $72 + 10 \log(P)$ dB in the 2285-2287.5 MHz band segment, and $75 + 10 \log(P)$ dB below 2285 MHz.⁴⁰¹ NTIA also suggests that WCS mobile/portable devices' OOB should be attenuated by a factor of not less than: $43 + 10 \log(P)$ dB in the 2300-2305 MHz band segment, $55 + 10 \log(P)$ dB in the 2296-2300 MHz band segment, $61 + 10 \log(P)$ dB in the 2292-2296 MHz band segment, $67 + 10 \log(P)$ dB in the 2288-2292 MHz band segment, and $70 + 10 \log(P)$ dB below 2288 MHz. Further, NTIA requests that the coordination distance for WCS base stations be increased to 145 kilometers (km) around the DSN site located in Goldstone, CA, from the existing 50-km coordination distance.⁴⁰² The current rules require a WCS OOB attenuation of $43 + 10 \log(P)$ dB in the 2300-2305 MHz amateur band and $70 + 10 \log(P)$ dB below 2300 MHz where the DSN operates, combined with a 50-km coordination distance around the Goldstone, CA DSN Facility.⁴⁰³

166. We believe it is important to ensure that the lower WCS spectrum is usable for broadband mobile deployment, while also protecting the DSN facility at Goldstone, CA. We find that the best way to achieve this is through the adoption of reasonable OOB limits combined with an adequate coordination distance for WCS base stations located near the Goldstone Facility. Therefore, we will adopt the OOB limits suggested by NTIA for WCS base, mobile, and fixed operations into the lower adjacent band to protect adjacent-band services operating below 2305 MHz, which also appear to be achievable with existing equipment designs and are not opposed by the WCS Coalition.⁴⁰⁴ We will also

³⁹⁹ The NASA Deep Space Network (DSN) is an international network that supports interplanetary spacecraft missions and radio and radar astronomy observations for the exploration of the solar system and the universe. See <http://deepspace.jpl.nasa.gov/dsn/> (last visited October 27, 2009).

⁴⁰⁰ See May 4, 2010, letter to Julius Knapp, Chief, Office of Engineering and Technology, from Karl B. Nebbia, Associate Administrator, Office of Spectrum Management, National Telecommunications and Information Administration, at 4 (NTIA May 4, 2010 Letter).

⁴⁰¹ *Id.*

⁴⁰² *Id.*

⁴⁰³ 47 C.F.R. §§ 2.106 fn US338, 27.53(a)(3).

⁴⁰⁴ See WCS Coalition April 30, 2010 *Ex Parte* Letter.

adopt NTIA's proposed coordination distance of 145 km for WCS base stations.⁴⁰⁵ We note that this coordination distance is based upon a line of sight calculation assuming a WCS antenna with a height of 300 meters, which could occur particularly in mountainous terrain but is not likely for the type of mobile applications that are being considered by WCS licensees. We also acknowledge that a coordination distance of 145 km is a significant increase from the requirements in footnote US338 of the U.S. Table of Frequency Allocations, which requires WCS licensees within 50 km of the Goldstone Facility to coordinate their facilities to minimize interference with DSN.⁴⁰⁶

167. Nevertheless, because there is only one DSN location within the United States, we believe this increased coordination distance is an additional precautionary measure that will ensure that the work at the Goldstone Facility is not interrupted. We also fully anticipate WCS base stations can be deployed well within the coordination distance once WCS licensees demonstrate that adequate shielding and engineering practices are being implemented to protect the DSN. The coordination for the DSN facility at Goldstone, CA, will be between NASA and the WCS licensees. Given that there is only one location in a relatively remote area, we do not anticipate that the 145-km coordination distance will impact the deployment of WCS. Additionally, if WCS equipment is manufactured with better OOB attenuation in the lower adjacent band, then WCS licensees will likely be able to coordinate base-station locations that are closer to the Goldstone Facility.

168. *Aeronautical Mobile Telemetry Service operations above the WCS bands.* The AMT Service's 2360-2390 MHz band is immediately adjacent to the upper 2360 MHz WCS band edge. AMT is used by the aerospace industry to collect critical data generated during flight testing of aircraft and missiles, such as stresses on control surfaces, engine temperatures, fluid pressures, and many other measurement points.⁴⁰⁷ WCS mobile and base stations are currently subject to an OOB attenuation requirement of $43 + 10 \log(P)$ dB in the 2360-2370 MHz band and $70 + 10 \log(P)$ dB above 2370 MHz.⁴⁰⁸

169. In response to the *2007 Notice*, AFTRCC filed comments requesting that the currently required OOB attenuation factor of $110 + 10 \log(P)$ dB into the SDARS band not only be retained, but formally extended to protect the AMT band as well.⁴⁰⁹ AFTRCC admits that it has benefited from the current $110 + 10 \log(P)$ dB OOB attenuation factor afforded to SDARS, which have effectively precluded mobile use of the WCS spectrum.⁴¹⁰ It claims that, under more relaxed rules that would facilitate the deployment of mobile and portable WCS stations and associated base stations, the signals from these WCS operations would raise the noise floor of AMT systems and cause data dropouts.⁴¹¹ AFTRCC contends that AMT receivers are sensitive and use highly directional eight-foot or larger antennas because AMT telemetry signals are frequently very weak and fluctuate due to the distance of the

⁴⁰⁵ We note that some amateur stations operating around 2304 MHz may experience an increased antenna noise temperature caused by the implementation of mobile WCS operations, and will have to tolerate this change in the RF environment. Due to the technical flexibility allowed to amateur stations in Part 97 of our rules, however, we believe that operators of these stations may be able to offset or mitigate the effects of this change by relocating or redirecting their antennas, or by making other permitted technical adjustments.

⁴⁰⁶ 47 C.F.R. §§ 2.106 footnote US338, 27.53(a)(1).

⁴⁰⁷ AFTRCC Comments at 2.

⁴⁰⁸ 47 C.F.R. § 27.53(a)(3).

⁴⁰⁹ AFTRCC Comments at 5.

⁴¹⁰ See Letter from William K. Keane, Counsel for Aerospace and Flight Test Radio Coordinating Council, to Marlene H. Dortch, Secretary, FCC (dated November 17, 2008) at 2 ("AFTRCC Nov. 17, 2008 *Ex Parte*").

⁴¹¹ *Id.* at 7.

aircraft from the receiving antenna, the low power of the aircraft transmitter, and the extreme maneuvers of the aircraft being tested, and therefore, these signals are vulnerable to increases in the noise floor.⁴¹² AFTRCC contends that WCS interference will have a direct impact on the ability of AMT operators to fly out to distances of up to 200 miles in order to comply with air traffic control requirements or to find acceptable test conditions.⁴¹³

170. To mitigate the risk of interference to AMT operations, AFTRCC suggests that if we relax the OOB attenuation requirements for WCS into the SDARS band, then we should increase the OOB attenuation to $70 + 10 \log (P)$ dB between 2360-2370 MHz and $90 + 10 \log (P)$ dB between 2370-2390 MHz for WCS mobile and portable stations and to $75 + 10 \log (P)$ dB between 2360-2370 MHz and $95 + 10 \log (P)$ dB between 2370-2390 MHz for WCS base stations.⁴¹⁴ AFTRCC also states that the WCS Coalition's proposed attenuation of $75 + 10 \log (P)$ dB for base station OOB into the SDARS band is designed to achieve this roll-off on the SDARS side of the band and OOB should achieve the same roll-off on the AMT side of the band. AFTRCC states that it would not object to allowing a reasonable grandfathering period – one year, for example – for a limited deployment of WCS equipment not meeting the OOB attenuation levels that it suggests.⁴¹⁵ AFTRCC later urged that WCS licensees be limited to transmitting only from base stations using the upper WCS bands and that WCS base stations be required to meet an OOB attenuation of $70 + 10 \log (P)$ dB at 2360 MHz band edge and above.⁴¹⁶ As an alternative to the limitation of base station-only transmissions in the upper WCS band, AFTRCC urges the creation of a 2.5-megahertz-wide guard band at 2357.5-2360 MHz in addition to the other technical limits it proposed on mobile WCS operations.⁴¹⁷

171. Additionally AFTRCC requests that power and OOB limits be measured on an EIRP basis (*i.e.*, after transmit antenna) rather than transmitter output power. Further, although AFTRCC originally stated that if average power is allowed, then peaks should be limited to 6-8 dB for no more than 0.1 percent of the time, it later stated that all powers should be expressed as peak power as currently outlined in Section 27.50(a).⁴¹⁸ AFTRCC contends that allowing average power measurement instead of peak power measurement would exacerbate WCS interference to AMT and, for 99 percent of the time, would allow WCS OOB levels into the AMT band corresponding to an attenuation of only $32 + 10 \log (P)$ dB.⁴¹⁹ In a subsequent *ex parte* filing, AFTRCC argues that allowing WCS to use average power measurements with a peak to average ratio of 13 dB rather than specifying peak power measurements will lead to a reduction of 13 dB in the level of OOB interference protection afforded to

⁴¹² AFTRCC May 7, 2008, *Ex Parte* at 3.

⁴¹³ AFTRCC April 23, 2010 Comments at 3.

⁴¹⁴ AFTRCC *Ex Parte* of November 17, 2008 at 5-6. AFTRCC arrives at these mobile and portable OOB attenuation levels accounting for 16 dB to reduce the maximum single device interference to the noise floor of the AMT receiver using free space propagation at a 1.5-mile (2.4 km) separation distance; 8 dB to account for aggregate interference from multiple devices; and 3 dB to account for multipath and other non-line-of-sight enhancements to interference signal strength. For base stations, AFTRCC includes an additional 5 dB to account for improved line of sight from a tower-mounted antenna to the AMT receiver site.

⁴¹⁵ See Letter from William K. Keane, Counsel for Aerospace and Flight Test Radio Coordinating Council, to The Honorable Kevin J. Martin, Chairman, FCC (dated December 1, 2008) at 3 (“AFTRCC Dec. 1, 2008, *Ex Parte*”).

⁴¹⁶ AFTRCC *ex parte* of March 19, 2010 at 15.

⁴¹⁷ *Id.*

⁴¹⁸ AFTRCC Comments at 6. In their *Ex Parte* filing dated September 15, 2009, at 15, AFTRCC suggests to retain peak power measurement consistent with existing rules.

⁴¹⁹ AFTRCC April 23, 2010 Comments at 3.

AMT telemetry operations.⁴²⁰ In addition, AFTRCC submits that allowing average measurements would result in a degradation of 8 dB from the current interference protection above 2370 MHz contained in the Commission's Rules.⁴²¹ AFTRCC also suggests that we require ATPC be employed for WCS base, mobile, and portable stations.⁴²² AFTRCC claims that these additional protections are necessary to avoid potential harmful interference to AMT operations.⁴²³

172. To further protect AMT receivers from harmful interference, AFTRCC suggests that the $75 + 10 \log (P)$ dB OOB attenuation for base stations should also be backed up by a coordination regime for WCS base stations that would be located within line of sight of an AMT receiver.⁴²⁴ AFTRCC claims that although the $43 + 10 \log (P)$ dB OOB attenuation level satisfies the ITU-R M.1459 power flux density protection level of $-180 \text{ dBW/m}^2/4\text{kHz}$ at distances over 100 km for an AMT ground receiving antenna pointing at a WCS mobile transmitter,⁴²⁵ a single WCS device at a distance of 18.67 km from an AMT receiver could cause interference to the receiver.⁴²⁶ Additionally, AFTRCC states that the WCS Coalition's proposed OOB attenuation of $55 + 10 \log (P)$ dB produces a separation distance of 32 km from AMT receivers in order to avoid causing interference to the receivers, while an OOB attenuation of $67 + 10 \log (P)$ dB produces a separation of 8 km to avoid causing interference.⁴²⁷

173. In its April 30, 2010, comments, AFTRCC reiterates its opposition allowing WCS mobile applications in the upper WCS band and support for its proposed technical constraints on WCS operations. AFTRCC also states that if the WCS technical rules are established as indicated in the *WCS/SDARS Technical Rules Public Notice*, then stringent coordination requirements would be needed, coupled with an unconditional and immediate obligation for WCS licensees to shut down any upper WCS-band base stations within line of sight of an AMT receiver upon receipt of a complaint of interference to AMT operations.⁴²⁸ AFTRCC contends that even an expedited Commission procedure for eliminating interference would be no substitute for such a procedure given the aviation safety issues at stake. Boeing also requests that the WCS transmitters be shut down if they cause interference and seeks more stringent coordination requirements; including the protection of mobile AMT receive operations and the protection of future AMT deployments, even if it requires modifications to or relocation of WCS operations.⁴²⁹ Boeing contends that the flexible use of mobile AMT sites is essential to effective and efficient flight testing. Boeing also requests that WCS licensees be required to provide a list of WCS base stations and their technical characteristics upon request by an AMT site operator.⁴³⁰

174. In its early comments in this proceeding, the WCS Coalition argued that its proposal to relax the OOB attenuation requirement in the 2320-2345 MHz band would not affect AMT

⁴²⁰ See *Ex Parte* Letter from William K. Keane, Counsel for Aerospace and Flight Test Radio Coordinating Council, filed May 13, 2010, at 2.

⁴²¹ *Id.*, Attachment at 3.

⁴²² AFTRCC Nov. 17, 2008, *Ex Parte* at 5.

⁴²³ AFTRCC Comments at 2-3.

⁴²⁴ AFTRCC Comments at 6.

⁴²⁵ AFTRCC Comments at 5.

⁴²⁶ AFTRCC August 14, 2009, *Ex Parte* detailing its conclusion to the tests conducted by WCS and SDARS.

⁴²⁷ AFTRCC Comments at 5.

⁴²⁸ AFTRCC April 23, 2010 Comments at 6.

⁴²⁹ Boeing April 23, 2010 Comments at iii, 2, 4.

⁴³⁰ *Id.* at 5.

operations.⁴³¹ Also, NextWave Wireless (NextWave) contends that the OOB attenuation factors of $43 + 10 \log (P)$ dB in the 2360-2370 MHz band and $70 + 10 \log (P)$ dB above 2370 MHz were established in 1997 and, although AFTRCC participated in the proceeding establishing the WCS rules, it did not petition for reconsideration of the adoption of those OOB attenuation requirements.⁴³² NextWave continues that there has been no interference to AMT operations from existing fixed WCS operations.⁴³³ Further, the WCS Coalition suggests that AFTRCC has failed to install appropriate filters and take other steps to protect against WCS operations.⁴³⁴ AFTRCC dismisses these arguments, stating that the only reason the aerospace companies have registered their concerns is because WCS licensees are contemplating a radical change in their use of the band that was not practical under the rules adopted in 1997.⁴³⁵ AFTRCC also states that for filters to be effective against WCS OOB, they would have to be added to the WCS transmitter, not the telemetry receiver.⁴³⁶

175. In response to AFTRCC's proposals, the WCS Coalition offered a more stringent attenuation of OOB into the AMT band in its March 15, 2010 *Ex Parte* filing.⁴³⁷ However, as a result of negotiations with NTIA, on April 30, 2010, the WCS Coalition updated its proposal for even more stringent OOB attenuation into the AMT band if the OOB attenuation into the lower adjacent band could be relaxed for WCS mobile devices.⁴³⁸ Specifically, the WCS Coalition and NTIA now agree that WCS base stations' OOB, as measured over a 1-megahertz resolution bandwidth, must be attenuated below the transmitter power P by a factor not less than $43 + 10 \log (P)$ dB in the 2360-2362.5 MHz band segment, $55 + 10 \log (P)$ dB in the 2362.5-2365 MHz band segment, $70 + 10 \log (P)$ dB in the 2365-2367.5 MHz band segment, $72 + 10 \log (P)$ dB in the 2367.5-2370 MHz band segment, and $75 + 10 \log (P)$ dB above 2370 MHz. Additionally, they agree that WCS mobile/portable devices' OOB, as measured over a 1-megahertz resolution bandwidth, must be attenuated below the transmitter power P by a factor not less than $43 + 10 \log (P)$ dB in the 2360-2365 MHz band segment, and $70 + 10 \log (P)$ dB above 2365 MHz.⁴³⁹ The WCS Coalition argues that adoption of AFTRCC's proposed OOB limits at 2305 MHz and 2360 MHz could have a material adverse impact on the utility of the lower A and upper B block channels for broadband and would effectively force WCS licensees to waste 2.5 megahertz of the lower A block and the upper B block closest to the band edges as guard band

⁴³¹ WCS Coalition Reply Comments at 52-53.

⁴³² See Letter from Jennifer M. McCarthy, Vice President, Regulatory Affairs, NextWave Wireless Inc., to Marlene Dortch, Secretary, FCC (dated November 23, 2008) at 1 ("NextWave Nov. 23, 2008, *Ex Parte*").

⁴³³ *Id.* at 2.

⁴³⁴ WCS Coalition Reply Comments at 52.

⁴³⁵ AFTRCC Dec. 1, 2008, *Ex Parte* at 2.

⁴³⁶ AFTRCC May 7, 2008, *Ex Parte* at 3.

⁴³⁷ In its March 15, 2010 *ex parte* filing, the WCS Coalition updated its position regarding emissions above 2360 MHz, stating that, given the state of filter technology, it would be able to meet base station OOB limits of $43 + 10 \log (P)$ dB at 2360 MHz, $55 + 10 \log (P)$ dB at 2362.5 MHz, $70 + 10 \log (P)$ dB at 2365 MHz and at 2367.5 MHz, $72 + 10 \log (P)$ dB at 2370 MHz, and $75 + 10 \log (P)$ dB above 2370 MHz. In addition, the WCS Coalition submits that it would be able to meet mobile and portable OOB limits of $43 + 10 \log (P)$ dB at 2360 MHz, $45 + 10 \log (P)$ dB at 2362.5, $55 + 10 \log (P)$ dB at 2365 MHz, $65 + 10 \log (P)$ dB at 2367.5 MHz, and $70 + 10 \log (P)$ dB at 2370 MHz. WCS Coalition March 15, 2010 *Ex Parte* presentation at 8-9.

⁴³⁸ See WCS Coalition April 30, 2010 *Ex Parte* letter at 2, 5.

⁴³⁹ WCS Coalition April 30, 2010 *Ex Parte* letter at 2, 5; and NTIA May 4, 2010 Letter at 2.

spectrum because practical filters could not achieve sufficient roll-off to meet the proposed mask absent a guard band.⁴⁴⁰

176. The WCS Coalition also states that the single greatest impediment in the staff's proposal to achieving the objectives in the National Broadband Plan is the coordination proposal to protect AMT facilities.⁴⁴¹ The WCS Coalition contends that the proposed 45-km coordination distance could delay if not preclude service to 25 percent of the population in the United States. Instead, they argue that even under worst case conditions for the upper B block, a 10-km coordination distance would provide adequate protection to AMT operations. The WCS Coalition states that it is difficult to square the proposed tighter OOB limits with a 45-km coordination distance, when the Commission required neither type of protections for AMT operations when it reallocated the 2385-2390 MHz band in WT Docket 02-8.⁴⁴² The WCS Coalition adds that coordination works best when both services have to coordinate with each other and there is an incentive to be reasonable. However, the WCS Coalition contends that even though the Commission staff has rejected AFTRCC's technical restrictions on WCS, the coordination requirement will allow AMT interests to hold WCS deployment hostage absent compliance with the rejected limits.⁴⁴³ The WCS Coalition also states that the 45-km coordination distance ignores attenuation characteristics that would minimize interference to AMT facilities and provides its own technical analysis supporting a 10-km coordination distance.⁴⁴⁴

177. GE Healthcare (GEHC) also asserts that the 45-km coordination distance is unnecessarily large and could stifle the deployment of WCS and broadband services. GEHC contends that AFTRCC's reliance on ITU-R M.1459 for protection levels for AMT and the use of free-space propagation assumptions are inappropriate and result in overly conservative assumptions that should not be applied to the WCS interference analysis.⁴⁴⁵ GEHC contends that even if one uses the inappropriate $-180 \text{ dBW/m}^2/4\text{kHz}$ protection level, a more realistic path-loss calculation would only result in a coordination distance of 17.8 km for a WCS base station meeting $43 + 10 \log (P) \text{ dB}$ at 2360 MHz.⁴⁴⁶ GEHC suggests that a 10-km coordination distance would be more than adequate between these 2 services. GEHC also submits that AMT receivers close to populated areas are already subject to OOB from numerous uncoordinated radio sources, including unlicensed devices, which far exceed the $-180 \text{ dBW/m}^2/4\text{kHz}$ protection level on a regular basis. Therefore, it would be inconsistent to hold WCS base stations to a higher standard than existing and ubiquitous unlicensed Part 15 and Part 18 devices currently meet in the AMT band.⁴⁴⁷ GEHC also points out that AFTRCC regularly coordinates and approves wireless video links in the AMT band to televise major sporting events and that these devices transmit at 250 mW and 1.5 W from airborne transmitters at locations throughout the country on a frequent basis. Finally, GEHC argues that the Commission staff's proposed coordination requirement lacks clarity with respect to the responsibility of both parties and urges that a deadline for resolution of coordination be established.

⁴⁴⁰ *Id.*

⁴⁴¹ WCS Coalition April 23, 2010 Comments at iii, 6-7.

⁴⁴² *Id.* at 8. The WCS Coalition acknowledges that the referenced allocation was later rescinded, but the principle of the finding remains valid.

⁴⁴³ *Id.* at 9.

⁴⁴⁴ *Id.* at 10 and Appendix B.

⁴⁴⁵ GEHC April 23, 2010 Comments at 2-3.

⁴⁴⁶ *Id.* at 4.

⁴⁴⁷ *Id.* at 5-6.

178. In its April 30, 2010 Reply Comments, AFTRCC continues to support the protection levels in ITU-R M.1459 as being appropriate to address potential interference between WCS and AMT operations. AFTRCC also disputes the technical analysis of GEHC and the WCS Coalition supporting a 10-km coordination distance and contends that the 45-km or line-of-sight coordination distance, whichever distance is greater, is reasonable.⁴⁴⁸ AFTRCC also argues that it is not reasonable to compare the emissions into the AMT band from Part 15 devices that are 10 megahertz above the upper edge of the AMT band at 2390 MHz to the WCS emissions that are adjacent to the lower band edge at 2360 MHz.⁴⁴⁹

179. As indicated above, on May 4, 2010, NTIA submitted a letter to the record recommending emission limits and a coordination requirement to allow broadband mobile applications for WCS, while also ensuring interference protection for Federal and non-Federal AMT operations.⁴⁵⁰ NTIA contends that the existing WCS OOB limits into the AMT band would not adequately protect AMT operations unless there was 10 megahertz of guard band between the services, which would result in a large amount of WCS spectrum being rendered unusable. Therefore, NTIA proposed emission limits that should be achievable with existing technology combined with a requirement that WCS base stations be coordinated when they are within 45 km or line of sight of an AMT receiver site, whichever distance is greater.⁴⁵¹ NTIA also contends there may be instances in which WCS facilities could be located on towers higher than the 30-meters above ground that was assumed in setting the coordination distance, or could be located on a mountain overlooking an AMT facility, and therefore interference to AMT receivers beyond the 45-km coordination distance, but within line of sight, could occur unless coordinated beforehand. Thus, NTIA expects that the WCS licensee will be immediately responsible for eliminating any interference situations, even if they occur beyond the 45-km coordination distance, and requests that WCS licensees be required to take all practical steps necessary to eliminate such interference.⁴⁵² Also, although the WCS Coalition and NTIA agree on the OOB limits in the AMT band, they disagree on the appropriate coordination distance.⁴⁵³

180. NTIA also recommends consideration of the following factors to reduce interference to AMT receivers: using the channels in the lower portion of the WCS band (2305-2320 MHz) for base stations that are located in areas with lower population densities; using lower antenna heights to minimize base station coverage; using down-tilt antennas for base stations to minimize the signal level in the direction of AMT sites; employing sector blanking to eliminate base-station coverage in the direction of AMT sites; reducing the transmitter power to minimize the base-station coverage areas; and employing terrain shielding where practical to reduce signal levels in the direction of AMT sites.⁴⁵⁴ NTIA also states that if line of sight is involved, the coordination process should also take into consideration other parameters of the AMT receiver (*e.g.*, antenna height and gain, minimum elevation angle, and terrain shielding). The operational area used for flight testing (*e.g.*, test ranges located away from populated areas or over the ocean) should also be considered in the coordination process. NTIA suggests that future technology advances, including better filtering for WCS base stations, should also be considered to facilitate coordination. NTIA also suggests that to minimize the need for coordination, WCS licensees operating in the 2345-2360 MHz band should avoid locating base stations within radio line of sight of

⁴⁴⁸ See AFTRCC April 30, 2010 Reply Comments at 4-6.

⁴⁴⁹ *Id.* at 9.

⁴⁵⁰ See NTIA May 4, 2010 letter at 1-3.

⁴⁵¹ A listing of current and planned Federal and non-Federal AMT receiver sites can be obtained from the Aerospace and Flight Test Radio Coordinating Council (AFTRCC).

⁴⁵² See NTIA May 4, 2010 letter at 3.

⁴⁵³ See WCS Coalition April 30, 2010 *Ex Parte* letter at 2, 5.

⁴⁵⁴ *Id.* at 4.

AMT receive sites, and if during the coordination process a mutual agreement as to the protection of AMT receivers cannot be reached, the FCC and NTIA should be notified to resolve any conflict. This includes interference that could occur to AMT receivers from WCS bas stations operating outside of the 45-km coordination distance.

181. *Discussion.* We believe it is possible to establish reasonable WCS limits that will allow mobile broadband operations, while also preventing harmful interference from occurring to AMT operations in the adjacent spectrum. First, we find the OOB attenuation factors suggested by AFTRCC are overly stringent and would likely render a meaningful portion of the upper WCS blocks unusable for effective mobile broadband applications. Therefore, we find that the best approach to address the spectrum boundary at 2360 MHz is to adopt reasonable OOB attenuation for WCS transmissions, coupled with a coordination requirement for WCS base stations, so that effective engineering practices can be applied in the design of WCS deployments around AMT installations. We agree with NTIA that the coordination process will allow for the application of technical and operational techniques that take into account the local surroundings of specific AMT sites, and will enable the protection of AMT receivers while also allowing WCS deployments in those areas around AMT receivers to the greatest extent possible.

182. Specifically, as outlined previously, we will tighten the OOB attenuation approach for WCS mobile and portable devices above 2360 MHz as follows: 43 + 10 log (P) dB in the 2360-2365 MHz, and 70 + 10 log (P) dB above 2365 MHz. Additionally, WCS base and fixed stations will still be required to meet the OOB attenuation of 43 + 10 log (P) dB in the 2360-2362.5 MHz band, 55 + 10 log (P) dB at 2362.5-2365 MHz band, 70 + 10 log (P) dB at 2365-2367.5 MHz band, 72 + 10 log (P) dB at 2367.5-2370 MHz band, and 75 + 10 log (P) dB above 2370 MHz. These limits are consistent with the agreement between NTIA and the WCS Coalition on how best to address possible interference into the AMT band.⁴⁵⁵ In our independent judgment, we find that these limits strike an appropriate balance between our competing goals of protecting AMT operations and promoting provision of broadband mobile services by WCS licensees. Although these limits are more stringent than we typically require for mobile services, they appear to be achievable with currently available equipment technology. These limits will also be accompanied by conservative coordination distances that will allow the parties to engineer solutions to co-exist depending on the particular deployment scenarios for each facility.

183. Regarding our decision to establish a coordination process between WCS base stations and AMT receivers, we acknowledge that coordination between adjacent spectrum allocations is not the norm.⁴⁵⁶ In this instance, however, the limited number of AMT installations nationwide and AFTRCC's experience as a frequency coordinator lead us to believe that coordination between WCS licensees and AFTRCC could be effective in reducing interference between these services, without overly burdening either service. While AMT interests make some effective arguments demonstrating that interference could occur over longer distances (*e.g.*, in situations where the main beam of the AMT receiver is pointed at the horizon, directly at a WCS base station transmitter, when the aircraft is operating at the outer fringes of its communications range), the WCS interests have equally demonstrated that WCS operations can be deployed well within our adopted coordination distance when real world deployment factors are considered (*e.g.*, typical terrain obstructions, down-tilt antennas by WCS base stations, and side-lobe suppression of AMT antennas will greatly reduce the interference potential). Therefore, although we are adopting the 45-km coordination distance and/or line of sight (whichever is greater) approach supported

⁴⁵⁵ See WCS Coalition April 30, 2010 *Ex Parte* letter at 2, 5.

⁴⁵⁶ However, in some limited instances, we have required inter-service coordination or other interference avoidance requirements to address possible interference scenarios between different services in adjacent spectrum. See, *e.g.*, 47 C.F.R. §§ 25.213, 25.254, 27.1131, and 95.861.

by AMT interests,⁴⁵⁷ we want to be clear that we are adopting this conservative coordination trigger only to allow thorough consideration of possible interference scenarios and it is in no way to be considered an exclusion zone around AMT facilities.

184. Although this coordination distance is conservative in that it does not consider terrain shielding or other propagation factors that would mitigate possible interference between these services and such a large coordination distance could slow deployment of WCS base stations near AMT facilities while coordination takes place, we find that adopting such a conservative coordination distance is preferable to adopting too small of a coordination distance and then having to address instances of harmful interference after the facilities are deployed and operational. We believe that in most cases, the line of sight from a WCS base station to an AMT receiver will be less than 45 km, but to account for the possibility that a WCS base station could be deployed on a mountain overlooking an AMT facility, we will require coordination for a radius of 45 km or line of sight from the AMT receiver, whichever distance is greater. In addition, we note that because the WCS Coalition is considering the use of TDD technology for the WCS band, the lower WCS-band channels can be used in areas around AMT receivers even if use of the upper WCS-band channels is hindered. Also, although the interference protection mechanism outlined in Recommendation ITU-R M.1459⁴⁵⁸ has been used in the past for the coordination of base stations and AMT receivers,⁴⁵⁹ we will rely upon the AMT entity and the WCS licensee to use accepted engineer practices and/or standards to evaluate each AMT/WCS deployment based on the relevant operating characteristics and to come to a mutually acceptable agreement. Although the line of sight distance will be likely less than 45 km in most cases, to account for the possibility that a WCS base station or AMT receiver could be higher than 30 meters above ground or deployed on a mountain overlooking an AMT facility, we will require coordination for a minimum of 45 km or line of sight, whichever is greater.

185. We will also require WCS licensees and AMT receiver operators to cooperate in good faith in the coordination and deployment of WCS and AMT facilities. WCS licensees must also cooperate in good faith in the selection and use of new station sites and new frequencies when within radio line of site of AMT receiver facilities to minimize the potential for harmful interference and make the most effective use of the authorized facilities. If the parties are not able to reach a mutually acceptable coordination agreement in an acceptable timeframe, either party can approach the Wireless Telecommunications Bureau of the FCC, which, in cooperation with the Office of Engineering and Technology and NTIA, may impose restrictions including specifying the transmitter power, antenna height, or area or hours of operation of the stations. Licensees of stations suffering or causing harmful interference must also cooperate in good faith to resolve such problems by mutually satisfactory arrangements. At this time, we decline to specify a specific timeframe within which parties must remedy interference because we believe the complexity and demand on resources will vary from deployment to deployment. The details for remedying interference should be thoroughly documented in the coordination agreements between the WCS and AMT licensees. We would expect the agreements to contain sufficient specificity as to the mechanism, response time, and points of contact needed to expeditiously remedy harmful interference, should it occur. If it appears the parties are not able to work to a mutually acceptable arrangement within a reasonable time period, we may reconsider this decision in the future and

⁴⁵⁷ We note that the 45-km coordination distance proposed by NTIA would be the line of sight distance for an AMT receiver at a 30-meter height pointed at a WCS base station at a 30-meter height assuming a smooth earth with no terrain obstructions.

⁴⁵⁸ See Recommendation ITU-R M.1459, "Protection criteria for telemetry systems in the aeronautical mobile service and mitigation techniques to facilitate sharing with geostationary broadcasting-satellite and mobile-satellite services in the frequency bands 1 452 1 525 and 2 310 2 360 MHz." This Recommendation provides the framework for conducting sharing studies between the mobile aeronautical test service and the mobile satellite service.

⁴⁵⁹ See 47 C.F.R. § 25.253(f)(2), Mobile Satellite Service Ancillary Terrestrial Component base stations.

establish specific deadlines for remedying the interference. We also expect the coordinating parties to share accurate and relevant information in a timely and efficient manner. This applies equally to the AFTRCC on behalf of the AMT community, NASA, and the WCS licensees. This coordination also must address instances where an AMT licensee wishes to deploy temporary or future AMT facilities.

186. We note that both of these services have primary status in their allocation, so we reject the AMT interests' request that mobile, transient, and future AMT deployments have priority status over WCS deployments. We also reject their request that WCS operations be required to immediately cease operation at the request of an AMT operator. Such requirements would essentially elevate the allocation status of AMT over that of WCS and we are not persuaded that such action is appropriate or justified. Further, as is typically the case when co-primary services coordinate, we find a first-in, first-protected coordination approach is appropriate to address future AMT deployments. We will also require the parties to resolve interference complaints swiftly and in a mutually acceptable manner or either party may request intervention by the Commission. We also encourage the parties to work together to address any special needs each party might have. Although we adopt a conservative coordination distance, we do not anticipate the creation of large exclusion zones around AMT facilities or for WCS to lock out or impede future AMT growth. Our analysis of the record leads us to believe that these two services are capable of operating in adjacent spectrum if they consider real world factors and deploy facilities in consideration of their environment. We will also require the parties in the coordination process to determine what modifications to either parties' facilities would be considered minor, and the modifications that would be considered major and in need of subsequent coordination. We believe WCS mobile/portable operations and base stations would likely be shielded by foliage, buildings, and other structures that would attenuate the WCS emissions. We believe that WCS base stations should be able to operate within the coordination area if they use sound engineering practices and take local conditions into account. We also reject the idea of the exclusion zones around AMT test facilities because we believe any potential interference can be better evaluated in light of the specific factors applicable at each specific AMT receive location and mitigated with coordination between the parties.

187. Finally, we reject AFTRCC's suggestions that we limit the use of the 2345-2360 MHz portion of the WCS spectrum to fixed transmitters, and that power be limited to peak power because these suggestions would unnecessarily limit the technology and service choices of the licensees. Although, as AFTRCC notes, average power measurement instead of peak power measurement also influences the amount of signal energy allowed outside of the band under our OOB limits, we do not find it is necessary to limit the technology choices of the WCS licensees to prevent WCS from causing harmful interference to AMT receivers.⁴⁶⁰ As outlined above, we are adopting very conservative coordination protections for AMT facilities that are more than adequate to allow for the consideration of the WCS licensees' technology choices, including average power measurement and mobile device operations in the 2347.5-2360 MHz band.

G. Performance Requirements

1. Background

188. On March 29, 2010, the Commission issued a public notice requesting comment on possible revision of the performance requirements (also known as buildout or construction requirements) for the 2.3 GHz WCS band.⁴⁶¹ In the public notice, we asked whether the Commission should replace the

⁴⁶⁰ See AFTRCC *Ex Parte* filing (filed May 13, 2010).

⁴⁶¹ See "Federal Communications Commission Requests Comment on Revision of Performance Requirements for 2.3 GHz Wireless Communications Service," WT Docket No. 07-293, *Public Notice*, FCC 10-46 (rel. March 29, 2010) (*WCS Performance Public Notice*). A summary of the Public Notice was published in the *Federal Register*

current WCS substantial service performance requirement⁴⁶² with enhanced performance benchmarks if we decide to modify technical requirements for the WCS band.⁴⁶³ Specifically, we sought comment on whether, for mobile and point-to-multipoint services, we should require a licensee to provide reliable signal coverage to 40 percent of a license area's population within 30 months, and 75 percent of a license area's population within 60 months.⁴⁶⁴ We also asked whether, for point-to-point fixed services, the Commission should require construction and operation of 15 point-to-point links per million persons in a license area within 30 months, and 30 point-to-point links per million persons within 60 months, together with a minimum payload capacity to ensure that the spectrum is used intensively.⁴⁶⁵

189. In the public notice, we also asked whether the Commission should require WCS licensees to satisfy submarket construction requirements in addition to satisfying the above construction requirements for each license market area. For Major Economic Area (MEA) licenses, the submarkets would be Economic Areas (EAs), and for Regional Economic Area Grouping (REAG) licenses, the submarkets would be MEAs.⁴⁶⁶ Specifically, we asked whether for mobile and point-to-multipoint services, in addition to the performance requirements for licensed market areas discussed above, we should require licensees to serve 25 percent of each submarket's population within 30 months, and 50 percent of each submarket's population within 60 months.⁴⁶⁷ For fixed point-to-point systems, we requested comment on the minimum number of links we should require licensees to construct and operate in each submarket within 30 and 60 months, respectively.⁴⁶⁸ Finally, we sought comment on whether a license should automatically terminate in its entirety if a licensee failed to meet either its license area benchmark, or any related submarket benchmark.

190. Individual comments on the public notice were filed by Broadband South LLC, a WCS spectrum lessee (Broadband South), WCS licensee Horizon Wi-Com, LLC (Horizon), WCS licensee Stratos Offshore Services Company (Stratos), and Sirius XM. The WCS Coalition filed comments on behalf of two AT&T WCS licensee subsidiaries (BellSouth Mobile Data, Inc., and AWACs, Inc.), Horizon, NextWave–NW Spectrum Co (NextWave), and WCS Wireless License Subsidiary, Inc. (Sprint).⁴⁶⁹ Green Flag Wireless, LLC, CWC License Holding, Inc. and James McCotter (collectively, Green Flag), which filed applications that compete with the renewal applications filed in 2007 by certain WCS licenses, filed joint comments. Reply comments were filed by AT&T (on behalf of its WCS

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on April 6, 2010. 75 Fed. Reg. 17349 (April 6, 2010). Comments and reply comments were due on or before April 21 and May 3, 2010, respectively.

⁴⁶² Section 27.14(a) of the Commission's rules provides that 2.3 GHz WCS licensees "must, as a performance requirement, make a showing of 'substantial service' in their license area within the prescribed license term set forth in § 27.13." 47 C.F.R. § 27.14(a). The rule defines substantial service "as service which is sound, favorable and substantially above a level of mediocre service which just might minimally warrant renewal." *Id.* Section 27.14(a) provides that failure by any WCS licensee to meet its performance "requirement will result in forfeiture of the license and the licensee will be ineligible to regain it." *Id.*

⁴⁶³ *WCS Performance Public Notice* at 1.

⁴⁶⁴ *Id.* at 2.

⁴⁶⁵ *Id.*

⁴⁶⁶ *Id.* The WCS A and B blocks are licensed in 52 MEAs, which are comprised of 172 EAs; the WCS C and D blocks are licensed in 12 REAGs.

⁴⁶⁷ *WCS Performance Public Notice* at 2.

⁴⁶⁸ *Id.*

⁴⁶⁹ Sprint is the parent of WCS Wireless License Subsidiary, Inc.

licensee subsidiaries, AWACs, Inc. and BellSouth Mobile Data, Inc.), Broadband South, WCS licensee Comcast Corporation (Comcast), Green Flag; Horizon, the WCS Coalition, and Sirius XM.

2. Discussion

191. For the reasons stated below, we hereby adopt new performance requirements for the 2.3 GHz WCS band. The new requirements supersede the existing WCS substantial service performance requirement, and will commence on the effective date of the revised WCS technical rules adopted above.⁴⁷⁰

192. *Request for Further Notice of Proposed Rulemaking.* As an initial matter, we reject the claim of the WCS Coalition and others that they could not file informed comments on performance requirements due to uncertainty regarding the technical rule revisions we are adopting today.⁴⁷¹ These commenters argue that WCS licensees and the public had no clear guidance regarding which of the technical proposals advanced in the record would be adopted by the Commission.⁴⁷² The Commission has provided WCS licensees more than adequate notice of the technical requirements under consideration. In fact, on April 2, 2010, staff issued a public notice, which invited comment on the specific text of the likely technical rules.⁴⁷³ Interested parties thus have had ample opportunity to analyze and comment on the relationship of the technical and performance requirements under consideration.

193. We find that the record regarding performance requirements, as well as the technical rules, is well developed and there is no need to issue a Further Notice of Proposed Rulemaking as urged by the WCS Coalition. Indeed, the WCS Coalition and others filed detailed comments seeking adjustment of the proposed performance requirements, despite claiming that they lacked sufficient notice of the likely technical rules to inform their comments.⁴⁷⁴ We note that in response to the detailed comments of the WCS Coalition and others, we are easing performance requirements for license areas where a substantial portion of the population is within an aeronautical mobile telemetry (AMT) coordination zone.

194. Several parties also contend that delay is warranted because certain WCS renewal applications are pending or subject to challenge by third parties.⁴⁷⁵ Today, we are adopting a Notice of Proposed Rulemaking that commences a proceeding to examine the Commission's rules and policies governing the renewal of wireless radio services authorizations. In a companion order to that notice, we are granting all pending WCS renewal applications conditioned on the outcome of that proceeding.⁴⁷⁶ In

⁴⁷⁰ The revised technical rules will become effective 30 days after publication in the Federal Register subject to OMB approval for new information collection requirements.

⁴⁷¹ AT&T Reply Comments at 2 (filed May 3, 2010); Horizon Comments at 4-5 (filed April 21, 2010); WCS Coalition Comments at 7 (filed April 21, 2010).

⁴⁷² See, e.g., WCS Coalition Comments at 7 (filed April 21, 2010).

⁴⁷³ See *WCS/SDARs Technical Rules Public Notice*, DA 10-592 (rel. April 2, 2010).

⁴⁷⁴ See, e.g., WCS Coalition Comments at 12-23 (filed April 21, 2010); WCS Coalition Reply Comments at 3-12 (filed April 29, 2010).

⁴⁷⁵ See Broadband South Comments at 5 (filed April 21, 2010); Horizon Comments at 6 (filed April 21, 2010); WCS Coalition Comments at 11-12 (filed April 21, 2010).

⁴⁷⁶ See Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 To Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Policies and Procedures for Certain Wireless Radio Services; Imposition of a Freeze on the Filing of Competing Renewal Applications for Certain Wireless Radio Services and the Processing of Already-Filed Competing Renewal Applications, *Notice of Proposed Rulemaking and Order*, FCC 10-86 (adopted May 20, 2010).

view of the foregoing, we decline to postpone adoption of new performance requirements.⁴⁷⁷ We find that such delay is unnecessary and would be contrary to the public interest.

195. *Performance Requirements.* Our adoption of enhanced performance requirements below, together with today's revision of certain technical rules, will further the public interest by promoting the rapid deployment of new broadband services to the American public.⁴⁷⁸ Specifically, we find that requiring WCS licensees to meet enhanced performance requirements will serve the public interest by ensuring that underutilized spectrum will be used intensively in the near future. The new requirements will provide licensees much needed certainty regarding their construction obligations and will help ensure widespread system deployments.⁴⁷⁹

196. When the Commission originally adopted the 2.3 GHz WCS substantial service requirement in 1997, it was "the most liberal construction requirement adopted by the Commission to date."⁴⁸⁰ The Commission reasoned that "[p]articularly in light of the technological uncertainties associated with use of WCS spectrum to provide certain services consistent with the interference levels we adopt today, we believe that stringent build-out requirements are not warranted."⁴⁸¹ The Commission provided two examples of construction that would satisfy the substantial service requirement: (1) for fixed, point-to-point services, construction of four permanent links per one million people in a licensed service area; and (2) for mobile services, coverage of 20 percent of a license area's population.⁴⁸² Today, we are reducing the technological uncertainties that existed in 1997 by revising technical restrictions to enable WCS licensees to provide new high-value broadband and other innovative services in the band. Accordingly, enhanced performance requirements are appropriate.⁴⁸³

⁴⁷⁷ See, e.g., WCS Coalition Comments at 3-12 (filed April 21, 2010).

⁴⁷⁸ See Connecting America: The National Broadband Plan, Recommendation 5.8.1 ("the FCC should accelerate efforts to ensure that the WCS spectrum is used productively for the benefit of all Americans"). The National Broadband Plan is available at <http://www.broadband.gov/plan/>.

⁴⁷⁹ The enhanced requirements also are consistent with Congress' directive, under Section 309(j) of the Act, that we adopt "performance requirements, such as appropriate deadlines and penalties for performance failures, to ensure prompt delivery of service to rural areas, to prevent stockpiling or warehousing of spectrum by licensees or permittees, and to promote investment in and rapid deployment of new technologies and services." 47 U.S.C. § 309(j)(4)(B).

⁴⁸⁰ See *WCS Report and Order*, 12 FCC Rcd at 10843 ¶112.

⁴⁸¹ *Id.*

⁴⁸² *Id.*, at 10844 ¶113.

⁴⁸³ We disagree with Sirius XM's contention that we are required to auction new spectrum licenses because the revised technical rules afford WCS licensees enhanced spectrum rights. See Comments of Sirius XM on April 2, 2010 WCS/SDARS Technical Rules at 57-59. Our overriding goal in this proceeding is to promote the rapid deployment of innovative broadband services to the public in the WCS band. On balance, we believe that the public interest is better served here by applying the new performance requirements to the incumbent WCS licensees, within a more flexible technical regime, rather than attempting to displace the existing pool of WCS licensees or otherwise to restructure license assignments in order to license new spectrum rights by auction (with or without revised performance requirements). And it is the public interest that determines which mechanism should be used for modifying licenses or licensing new rights. See, e.g., Amendment of the Commission's Rules Regarding Multiple Address Systems, *Report and Order* in WT Docket No. 97-81, 15 FCC Rcd 16415 (2000) (holding that, under the relevant circumstances, the public interest would be best served by adopting a mixed licensing regime whereby certain types of MAS licenses would be subject to auction, but other types of these licenses would be structured to avoid mutual exclusivity and any consequent requirement to issue them by auction). Accordingly, we disagree with Sirius XM's contention that we are required to auction new spectrum licenses simply because the

(continued...)

a. Mobile and Point-to-Multipoint Service Performance Requirements

197. We find that to accomplish our goal of ensuring the rapid provision of innovative services to the public, the performance requirements that we adopt must be ambitious, yet reasonable, both temporally and quantitatively. Based on our analysis of the record in this proceeding and for the public interest reasons discussed above, we conclude that WCS licensees that provide mobile or point-to-multipoint services must provide reliable signal coverage to 40 percent of a license area's population within 42 months, and 75 percent of a license area's population within 72 months. We are thus extending by one full year the 30-month and the 60-month performance milestones that we proposed in the public notice.

198. We conclude that the revised requirements will promote the public interest by ensuring that there is meaningful deployment of new broadband services in the WCS band in the near future. The new requirements also will afford WCS licensees bright-line certainty regarding their performance obligations, and will facilitate Commission review of WCS performance showings.

199. The additional year that we are providing licensees to meet each performance benchmark responds in a measured way to the comments of the WCS Coalition and others that additional time is warranted to allow for the development and deployment of new equipment in the band.⁴⁸⁴ The record demonstrates that it would not be difficult to modify existing equipment to meet the technical parameters we are adopting today. The WCS Coalition, for example, foresees that it would take approximately 12 to 18 months to develop and commence deployment of mobile broadband service in the 2.3 GHz band.⁴⁸⁵ Based on the record, we believe that existing mobile WiMAX and other equipment can be adapted efficiently to comply with the revised WCS technical rules, and that the construction deadlines of 42 and 72 months provide adequate time for licensees to obtain financing, and reasonably accommodate equipment manufacturing and deployment cycles.

200. The 42- and 72-month milestones we are adopting today will accommodate the development and deployment of a range of technologies in the WCS band, including WiMAX. We note that according to the WiMAX Forum, there are currently 53 WiMAX systems deployed in the 2.3 GHz band and 112 systems in the 2.5 GHz band.⁴⁸⁶ There are also numerous certified WiMAX mobile devices that, with some modification, could be used in the 2.3 GHz WCS band under the revised technical rules that we adopt today, including broadband dongles, handsets, and netbooks.⁴⁸⁷ There are many major vendors of WiMAX equipment—including Airspan, Alcatel-Lucent, HTC, Huawei, Motorola, NEC,

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revised technical rules afford WCS licensees enhanced spectrum rights. *See* Sirius XM Comments at 57-59 (filed April 23, 2010).

⁴⁸⁴ Green Flag Comments at 4 (filed April 21, 2010); WCS Coalition Reply Comments at 6 (filed April 29, 2010). Columbia Capital notes that while established service providers “have a realistic possibility of meeting the Commission’s WCS [proposed] performance requirements,” doing so could be challenging for a new entrant that seeks to obtain venture capital financing. *See* Letter from James B. Fleming, Jr., Partner, Columbia Capital to Julius Genachowski, Chairman, FCC (dated May 12, 2010).

⁴⁸⁵ *See* Letter from Paul J. Sinderbrand, counsel for the WCS Coalition, to Marlene H. Dortch, Secretary, FCC, WT Docket 07-293 (dated May 11, 2010). WCS Coalition Comments at 6 (filed April 21, 2010).

⁴⁸⁶ *See* WiMAX Forum® Industry Research Report April, 2010 at 3. The report is available at <http://www.wimaxforum.org/resources/monthly-industry-report> (last visited May 14, 2010).

⁴⁸⁷ *See* <http://www.wimaxforum.org/certification/certified-product-showcase> (last visited May 14, 2010).

Nokia, Samsung and Tellabs—and they sold more than \$1 billion of equipment and devices in each of 2008 and 2009.⁴⁸⁸

201. Accordingly, we reject, as unsupported by the record, the WCS Coalition's claim that it is necessary to afford licensees a minimum of five years to serve 35 percent of a license area's population,⁴⁸⁹ and seven and one-half years to serve 70 percent of a license area's population, which the WCS Coalition argues will provide them with benchmarks comparable to certain 700 MHz requirements.⁴⁹⁰ In the 700 MHz proceeding, the Commission applied these lower benchmarks to licensees that must meet geographic, rather than population-based, performance requirements. We also are not persuaded by TelCom Ventures' claim that, based on the period it has taken Clearwire to develop and deploy WiMAX in the 2.5 GHz band and its current level of service, we should provide WCS licensees five years to serve 35 percent of a license area's population.⁴⁹¹ Indeed, we believe that Clearwire's trailblazing efforts to deploy WiMAX in the 2.5 GHz band will facilitate expeditious deployment of WiMAX services in the 2.3 GHz band.

202. *Submarket Performance Requirements.* Based on the record before us, we find that it is unnecessary to mandate specific construction requirements for each submarket within a WCS license area (*i.e.*, construction within each EA of an MEA license area and within each MEA of a REAG license area) to ensure extensive system deployments in the public interest.⁴⁹² We also note that this approach will provide WCS licensees additional flexibility to design and deploy systems in their principal license areas. We conclude that our general requirements to serve 40 percent of a license area's population within 42 months and 75 percent within 72 months are adequate to ensure that licensees will promptly put their spectrum to use and provide service to a significant portion of the population in their license areas.

203. *AMT Coordination Zones.* We adopt alternative performance requirements for aeronautical mobile telemetry zones, but reject the call of the WCS Coalition and others to exempt AMT coordination zones altogether from our revised performance requirements.⁴⁹³ While the requirement to coordinate with AMT sites may slow deployment in these areas, we reiterate that such zones are not exclusion zones. WCS licensees will be able to construct facilities within these areas.⁴⁹⁴ Instead, based

⁴⁸⁸ Infonetics Research: WiMAX equipment/device market up for third consecutive quarter, subscribers up 75 percent in '09, Report Highlights at 1 (March 1, 2010), available at <http://www.infonetics.com/pr/2010/4Q09-WiMAX-Market-Highlights.asp> (last visited May 14, 2010).

⁴⁸⁹ WCS Reply Comments at 8 (filed April 29, 2010). *Cf.* Green Flag Comments at 6 (filed April 21, 2010) (proposing we adopt a 35 percent population coverage requirement at four years).

⁴⁹⁰ WCS Reply Comments at 8 (filed April 29, 2010).

⁴⁹¹ Letter from Rajendra Singh, Chairman and President, Telcom Ventures, LLC to Julius Genachowski, Chairman, FCC (dated May 11, 2010).

⁴⁹² See *WCS Performance Public Notice* at 2 (proposing submarket construction requirements of 25 percent and 50 percent at 30 and 60 months, respectively). 700 MHz C block licensees must meet performance benchmarks for each EA of a REAG. The 12 REAG license areas include 172 EA license areas.

⁴⁹³ WCS Coalition Reply Comments at 6-8.

⁴⁹⁴ We note that approximately 25 percent of the U.S. population resides within AMT coordination zones. WCS licensees can serve this population, without undertaking any prior coordination, using the lower five megahertz portions of the WCS A and B spectrum blocks and the entire C spectrum block. There is thus 15 megahertz of contiguous spectrum available in the band for which no prior coordination is required. For a list of the non-federal AMT sites, see attachment to Letter from William K. Keane, Counsel for AFTRCC, to Marlene H. Dortch, Secretary, FCC, WT Docket 07-293 (dated May 10, 2010). For a list of federal AMT sites, see attachment to Letter from William K. Keane, Counsel for AFTRCC, to Marlene H. Dortch, Secretary, FCC, WT Docket 07-293 (dated May 12, 2010).

on the record before us, we are adopting alternative performance requirements for those license areas where WCS licensees that deploy mobile or point-to-multipoint systems in the upper five megahertz portions of the A and B blocks or the D block must undertake substantial coordination with AMT receive sites. We do so because in markets where a substantial portion of the population is within an AMT coordination zone, licensees may require additional time and resources to design, site and deploy base station facilities.

204. Therefore, to account for these considerations, we are reducing the construction thresholds in any market (MEA or REAG) where a licensee can demonstrate that at least 25 percent of the population is within an AMT coordination zone. Thus, in markets where at least 25 percent of the population is within an AMT coordination zone, licensees must provide reliable signal coverage to 25 percent (rather than 40 percent) of a license area's population within 42 months and 50 percent (rather than 75 percent) of a license area's population within 72 months. These alternative requirements do not apply to spectrum block C, which is not subject to AMT coordination. These tailored requirements will afford WCS licensees considerable leeway to deploy systems efficiently where they may face a challenge meeting our general requirements to serve 40 percent of a license area's population within 42 months and 75 percent within 72 months.

205. In sum, we find that based on the totality of the circumstances described above, the performance requirements we are adopting strike an appropriate balance between our goal of enabling the provision of timely, appreciable service to the public with accommodating the needs of licensees to secure financing and equipment. The performance requirements are achievable without unduly burdening licensees. Accordingly, we find that it is public interest to adopt the 40- and 75-percent performance benchmarks as proposed in the WCS Performance Public Notice, but are extending the performance periods to 42 and 72 months, respectively. The performance periods will commence on the effective date of the revised WCS technical rules adopted above.

b. Point-to-Point Fixed Service Performance Requirements

206. Based on the record before us, we are modifying our proposal to require licensees that provide point-to-point fixed services to construct and operate 15 point-to-point links per million persons in a license area within 30 months, and 30 point-to-point links per million persons in a license area within 60 months, together with a minimum payload capacity to ensure that the spectrum is used intensively.⁴⁹⁵ The WCS Coalition supports the proposed 15 and 30-link benchmarks but urges us to apply them at 5 and 7 and one-half years, respectively.⁴⁹⁶ We believe that uniform performance milestones are desirable for the 2.3 GHz WCS band. Therefore, consistent with our approach above governing mobile and point-to-multipoint services in the band, we are extending each point-to-point fixed service milestone by 1 year, to 42 months and 72 months.

207. Accordingly, WCS licensees that provide a point-to-point fixed service must construct and operate a minimum of 15 point-to-point links per million persons in a license area within 42 months (one link per 67,000 persons), and 30 point-to-point links per million persons in a license area within 72 months (one link per 33,500 persons). The exact link requirement is calculated by dividing a license area's total population by 67,000 and 33,500 for the first and second milestones, respectively, and then rounding upwards to the next whole number.⁴⁹⁷ For a link to be counted towards these benchmarks, both

⁴⁹⁵ *WCS Performance Requirements Public Notice* at 2.

⁴⁹⁶ WCS Reply Comments at 8 n.20 (filed April 29, 2010).

⁴⁹⁷ For example, if a license area's population is 175,000, a licensee must construct at least 3 links ($180,000/67,000=2.68$, rounded upwards to 3) within 42 months, and at least 6 links ($180,000/33,500=5.37$, rounded upwards to 6) within 72 months.

of its endpoints must be in the license area. If only one endpoint of a link is in a license area, it may be counted as a half link towards the benchmarks. We find that these requirements are achievable, and will further our goal of ensuring meaningful wireless deployment. Because it will be easier to coordinate point-to-point systems in the vicinity of AMT receive sites,⁴⁹⁸ we find that it is not necessary to reduce the applicable construction thresholds as we do above for mobile and point-to-multipoint systems in certain license areas.

208. *Submarket Performance Requirements.* Based on the record before us, we find that it is unnecessary to also mandate construction requirements for each submarket of a license area (*i.e.*, construction within each EA of an MEA license area and within each MEA of a REAG license area) to ensure widespread system deployments in the public interest. We find that our general requirements to construct and operate a minimum of 15 point-to-point links per million persons in a license area within 42 months, and 30 point-to-point area within 72 months, are sufficient to ensure that licensees use their spectrum intensively.

209. *Minimum Payload Requirement.* In the public notice, we also sought comment on whether, for point-to-point services, we should adopt a minimum payload capacity requirement to ensure that the WCS spectrum is used intensively.⁴⁹⁹ We find that a minimum payload capacity requirement will serve the public interest by ensuring that point-to-point systems are constructed to provide robust services to the American public. Second, and equally important, a minimum payload requirement will discourage the construction of skeletal systems and fulfill Congress' mandate that we adopt performance requirements to help "prevent stockpiling or warehousing of spectrum by licensees or permittees, and to promote investment in and rapid deployment of new technologies and services."⁵⁰⁰ Several parties commented on this requirement and urged us to craft a minimum payload requirement that will achieve these objectives while affording licensees flexibility to design and deploy systems efficiently.⁵⁰¹

210. Based on the record before us, we find that our goal to ensure that the WCS spectrum is used intensively in the public interest will be furthered by requiring that each point-to-point link have a minimum payload capacity (megabits/second (Mbits/s) for a given bandwidth). We agree with the WCS Coalition that the capacity requirements in section 101.141(b) of our rules—which require for nominal bandwidths of 1.25, 2.5, 3.75 and 5 megahertz, a minimum payload capacity of 3.08 Mbits/s, 6.17 Mbits/s, 12.30 Mbits/s, and 18.5 Mbits/s, respectively—may require more construction than would be necessary to ensure meaningful deployment in certain markets.⁵⁰² Rather, we believe that the less stringent payload requirement specified in section 101.141(a) of the rules⁵⁰³ is sufficient to ensure that the valuable WCS spectrum is used efficiently and intensively, while affording licensees ample flexibility to

⁴⁹⁸ In a fixed point-to-point system deployment, communication signals are sent between two stationary facilities using highly directional antennas, which focus the signal energy into a pencil beam. Mobile system deployments, by contrast, typically require construction of multiple interdependent base stations, which communicate with mobiles within a point radius of the base station's antennas to achieve service over a wide area. Fixed systems can tightly control the direction of their signal and thus are better able to coordinate deployments near adjacent spectrum users.

⁴⁹⁹ *WCS Performance Public Notice* at 2.

⁵⁰⁰ 47 U.S.C. § 309(j)(4)(B).

⁵⁰¹ See AT&T Reply Comments at 3 (filed May 3, 2010) (supporting adoption of payload requirements based on section 101.141(a); Letter from Christine Crowe, counsel for Stratos, to Secretary, FCC, dated Apr. 26, 2010 (same); WCS Coalition Comments at 19-22 (same) (filed April 21, 2010); *but, cf.* Green Flag Comments at 7 (filed April 21, 2010) (opposing payload requirements).

⁵⁰² WCS Coalition Comments at 20-21 (filed April 21, 2010).

⁵⁰³ See 47 C.F.R. § 101.141(a).

design fixed systems, and therefore adopt an analogous requirement here. Specifically, a fixed link must provide a minimum bit rate, in bits per second, equal to or greater than the bandwidth specified by the emission designator in Hertz (*e.g.*, equipment transmitting at a 5-Mbits/s rate must not require a bandwidth greater than 5 MHz), except the bandwidth used to calculate the minimum rate may not include any authorized guard band.

211. *Gulf of Mexico.* We note that the deployment and provision of wireless telecommunications services in the Gulf of Mexico presents unique circumstances, and we therefore tailor the WCS point-to-point performance requirements accordingly. We also note that application of our general performance metrics, which are based on population counts, would yield anomalous and insubstantial performance benchmarks for Gulf of Mexico licensees.⁵⁰⁴ Accordingly and for the reasons stated below, we will require the construction and operation of 15 point-to-point links at both 42 and 72 months from the effective date of the new WCS technical rules for each WCS spectrum block in the Gulf.

212. Stratos Offshore Services Company currently holds all four WCS licenses for the Gulf.⁵⁰⁵ Stratos has deployed and is operating 200 fixed point-to-point transmitters within its Gulf service area (32 on the A block, 122 on the B block, and 23 on each of the C and D blocks).⁵⁰⁶ Stratos explains that while its total link count is generally stable, it can vary as links are discontinued and replaced. On average, 5 percent of Stratos' links may be discontinued in a given month, and its link count on a given day therefore may not reflect the level of service it has been providing.⁵⁰⁷ Stratos argues that given this variability, we should allow it to count a link towards its performance requirements if it is either operational on the performance date or, if discontinued, was operational within one year of the performance date for 12 continuous months.⁵⁰⁸ We find it unnecessary to adopt such a requirement, and note that even if its link-count were to decrease 20 percent, Stratos would still meet the performance requirements for each of its spectrum blocks licensed in the Gulf.

213. We note that Stratos has used WCS and other spectrum solutions to provide service in the Gulf for over a decade and now serves over 60 percent of the oil and gas platforms in the Gulf.⁵⁰⁹ We also note that the market for communications services in the Gulf is generally limited. Because the potential for increasing its coverage or customer base in the Gulf is limited and because Stratos already provides significant services in the Gulf, we find that it would be inequitable to require the company to meet performance requirements materially above its current level of service. Accordingly, we are adopting the same performance requirement of construction and operation of 15 point-to-point links at both 42 and 72 months for each of its WCS spectrum blocks in the Gulf of Mexico. These requirements acknowledge the level of service that Stratos currently provides in the Gulf and provide Stratos certainty regarding its minimum performance obligations.

⁵⁰⁴ See Stratos Comments at 4 (filed April 21, 2010) (based on an estimated population of less than 100,000 in the Gulf of Mexico license area, a licensee would only have to construct one fixed link per spectrum block on a pro rata basis).

⁵⁰⁵ Stratos' WCS call signs are KNLB212, KNLB319, KNLB320 and KNLB321. The company serves over 100 oil and gas exploration and production platforms in the Gulf, using microwave, satellite, and other forms of radio communications. Stratos Comments at 1 (filed April 21, 2010).

⁵⁰⁶ Stratos Comments at 1 (filed April 21, 2010).

⁵⁰⁷ *Id.* at 4.

⁵⁰⁸ *Id.* at 5.

⁵⁰⁹ *Id.* at 3.

c. Performance Penalties

214. Consistent with the *WCS Performance Public Notice*, we conclude that a WCS license will automatically terminate without further Commission action if a licensee fails to meet a performance benchmark.⁵¹⁰ We disagree with the WCS Coalition and others who argue that this approach is unfair.⁵¹¹ In fact, the approach is entirely consistent with the approach adopted in the 1997 *WCS Report and Order*. There, the Commission explained unequivocally that “[l]icensees failing to demonstrate that they are providing substantial service will be subject to forfeiture of their licenses.”⁵¹² This approach applies to nearly all geographically-licensed wireless services. The wireless industry has invested tens of billions of dollars over the past decade and thrived under this pragmatic approach. We are therefore not persuaded that retaining the approach would deter capital investment.

215. We find no basis in the record to adopt a “keep-what-you-use” approach similar to that adopted for certain 700 MHz licenses as urged by the WCS Coalition and others.⁵¹³ The approach, which applies to select 700 MHz band licensees, is specifically tied to submarket performance requirements. We note, for example, that 700 MHz C Block REAG licensees must meet performance requirements in each Economic Area (EA) of their REAG license areas. In the 700 MHz proceeding, the Commission provided that if a licensee failed to build a submarket, it would only lose that submarket.⁵¹⁴ We are not requiring WCS licensees to undertake any submarket construction and find the keep-what-you-use approach inapposite.

216. We also note that a central component of the keep-what-you-use paradigm used in the 700 MHz context cannot be applied to the 2.3 GHz WCS band. Under the paradigm, if a 700 MHz C-block REAG licensee fails to meet its initial 40-percent performance requirement in even a single Economic Area (submarket), its REAG license term would be reduced by two years and its end-of-term construction requirement would be accelerated accordingly.⁵¹⁵ The current WCS license term expires on July 21, 2017. Thus, under keep-what-you-use, if a WCS licensee missed their first benchmark (at 5 years as urged by the WCS Coalition for example), it would then have to meet its accelerated end-of-term requirement immediately. Such an approach is untenable.

217. Nor are we moved by the WCS Coalition’s claim that if a licensee were to serve “74.49999 percent of the population of its authorized serve area,” it would “be forced to immediately cease its service offerings” for noncompliance with the 75-percent population coverage requirement.⁵¹⁶ The public interest requires that we closely examine such situations and, where appropriate, afford a licensee a reasonable opportunity to fulfill their obligations.⁵¹⁷ Further, as the WCS Coalition should be

⁵¹⁰ *WCS Performance Public Notice* at 2.

⁵¹¹ See, e.g., WCS Coalition Comments at 18 (filed April 21, 2010); Horizon Comments at 5 (filed April 21, 2010).

⁵¹² See *WCS Report and Order*, 12 FCC Rcd at 10843 ¶113. Section 27.14(a) codifies this penalty and provides that failure by any WCS licensee to meet its performance “requirement will result in forfeiture of the license and the licensee will be ineligible to regain it.” 47 C.F.R. § 27.14(a).

⁵¹³ Green Flag Comments at 6 (filed April 21, 2010); WCS Coalition Comments at 18-19 (filed April 21, 2010).

⁵¹⁴ See Service Rules for the 698-746, 747-762 and 777-792 MHz Bands, WT Docket No. 06-150, *et al.*, *Second Report and Order*, 22 FCC Rcd 15289, 15356 ¶163 (2007) (subsequent history omitted).

⁵¹⁵ 47 C.F.R. § 27.14(h).

⁵¹⁶ WCS Coalition Comments at 19 (filed April 21, 2010).

⁵¹⁷ The Commission may grant a waiver where it finds that the purpose of a rule would not be served and that a grant of the waiver would be in the public interest. See 47 C.F.R. § 1.925(b)(3)(i). See also 47 C.F.R. § 1.946(e)(1) (continued...)

well aware, the Commission has consistently afforded licensees ample time to wind up operations where they have had actual subscribers but materially failed to meet their performance requirements.⁵¹⁸ Accordingly, we adopt our proposal that a WCS license will terminate automatically without Commission action if a licensee fails to meet its performance requirements.

d. Relationship of New and Original Performance Requirements

218. The new performance requirements supersede the substantial service performance requirement for all WCS licensees, including any licensee that previously filed a substantial service demonstration.⁵¹⁹ Thus, we hereby dismiss as moot all pending requests for an extension of time to demonstrate substantial service.⁵²⁰ We also dismiss as moot an application for review of the Wireless Telecommunications Bureau's *Horizon Order*,⁵²¹ jointly filed by Green Flag and James McCotter. In that order, the Mobility Division dismissed as untimely a challenge to four substantial service performance showings of Horizon for its 2.3 GHz WCS licenses, and denied a request to reconsider or rescind acceptance of four other Horizon showings.⁵²²

219. Although Comcast acknowledges the Commission's authority "to change a licensee's performance obligations under proper circumstances," it claims that doing so here could undermine investment in new wireless services.⁵²³ We disagree. Comcast and Broadband South both argue that any licensee that demonstrates substantial service on or before July 21, 2010 should not be subject to further performance requirements.⁵²⁴ Horizon likewise argues that we should exempt it from any new performance requirements, noting that the Wireless Telecommunications Bureau accepted its substantial service showings in 2007.⁵²⁵ We find that our goal of intensive use of the WCS spectrum in the public interest will best be served by requiring all WCS licensees to meet the new performance requirements. We also find that the public interest will be served by the regulatory certainty afforded by uniform application of the performance requirements in the 2.3 GHz band.

220. However, to the extent that Horizon (or any other licensee or interested party) has constructed and is operating facilities that meet the new performance requirements and provided that such

(Continued from previous page) _____

("An extension request may be granted if the licensee shows that failure to meet the construction or coverage deadline is due to involuntary loss of site or other causes beyond its control.").

⁵¹⁸ See, e.g., Comtec Communications, Inc., Request for Waiver of Automatic Cancellation of 900 MHz Specialized Mobile Radio Service Licenses, *Order*, 23 FCC Rcd 8789 (WTB 2008) (providing licensee 180 days to facilitate subscribers' transition to an alternate service provider); Pinpoint Wireless, Inc., Request for a Waiver and Extension of the Broadband PCS Construction Requirements, *Order*, 18 FCC Rcd 1904 (WTB 2003) (same).

⁵¹⁹ Substantial service demonstrations were filed for only 20 of 155 WCS licenses by the end of the initial 10-year license term (July 21, 2007). In December 2006, the Wireless Telecommunications Bureau granted a three-year extension of the initial WCS construction deadline, until July 21, 2010, for certain WCS licensees. See Consolidated Request of the WCS Coalition for Limited Waiver of Construction Deadline for 132 WCS Licenses, *Order*, 21 FCC Rcd 14134 (WTB 2006).

⁵²⁰ A list of such requests is provided in Appendix F hereto.

⁵²¹ Applications of Horizon Wi-Com, LLC, File Nos. 0003014435, 0003014449, 0003014463, 0003014470, 0003045272, 0003045277, 0003045282, and 0003067727, *Memorandum Opinion and Order*, 24 FCC Rcd 359 (WTB Mobility Div. 2009) (*Horizon Order*).

⁵²² *Id.*

⁵²³ See Comcast Reply Comments at 4 (filed May 3, 2010).

⁵²⁴ *Id.*; Broadband South Comments at 6-7 (filed April 30, 2010).

⁵²⁵ Horizon Comments at 3-4 (filed April 21, 2010).

facilities are operational on any applicable future performance milestone, it will count towards meeting the performance obligations. To the extent that Broadband South or another party has undertaken any construction and operation towards meeting that standard, it too may be counted towards any future performance obligation provided that it comports with the new performance standards.

221. The new performance requirements also supplant AT&T's obligation to serve 25 percent of the population for each of its WCS licenses for mobile or point-to-multipoint services, or to construct at least five permanent links per one million people in the service area for fixed point-to-point services.⁵²⁶ Further, because the new performance requirements supersede the substantial service requirement for all WCS licensees, it is unnecessary for the Wireless Telecommunications Bureau to process any pending substantial service demonstrations, and any such demonstrations and pleadings filed in opposition are hereby dismissed as moot.

e. Compliance Procedures

222. Consistent with section 1.946(d) of the Commission's rules, we will require WCS licensees to demonstrate compliance with the new performance requirements by filing a construction notification within 15 days of the relevant milestone certifying that they have met the applicable performance benchmark.⁵²⁷ Each construction notification must include electronic coverage maps and supporting documentation, which must be truthful and accurate and must not omit material information that is necessary for the Commission to determine compliance with its performance requirements.⁵²⁸

223. Electronic coverage maps must accurately depict the boundaries of each license area (REAG or MEA) in the licensee's service territory. Further, REAG maps must depict MEA boundaries and MEA maps must depict EA boundaries. If a licensee does not provide reliable signal coverage to an entire license area, its map must accurately depict the boundaries of the area or areas within each license area not being served. Each licensee also must file supporting documentation certifying the type of service it is providing for each REAG or MEA within its service territory and the type of technology used to provide such service. Supporting documentation must include the assumptions used to create the coverage maps, including the propagation model and the signal strength necessary to provide reliable service with the licensee's technology.⁵²⁹

224. We note that the technical rules adopted today are technology neutral and will enable licensees in the 2.3. GHz Band to select from a variety of technologies to provide a range of services. Coverage determinations therefore may need to be made on a case-by-case basis to account for the variety of services and technologies that may be offered in the band. We seek to ensure that the above requirements are implemented consistently, and therefore we hereby delegate to the Wireless Telecommunication Bureau the responsibility for establishing the specifications for filing maps and other documents (*e.g.*, file format and appropriate data) needed to determine a licensee's compliance with the new performance requirements. If the Commission determines that a licensee has not met its requirements

⁵²⁶ See AT&T Inc. and BellSouth Corporation; Application for Transfer of Control, WC Docket No. 06-74, *Memorandum Opinion and Order*, 22 FCC Rcd 5662, 5816 (2007).

⁵²⁷ See 47 C.F.R. § 1.946(d) ("notification[s] must be filed with Commission within 15 days of the expiration of the applicable construction or coverage period").

⁵²⁸ See, *e.g.*, 47 C.F.R. § 1.17 (Truthful and accurate statements to the Commission); 47 C.F.R. § 1.917(c) ("[w]illful false statements . . . are punishable by fine and imprisonment, 18 U.S.C. 1001, and by appropriate administrative sanctions, including revocation of station license pursuant to 312(a)(1) of the Communications Act of 1934, as amended").

⁵²⁹ After a review of the record, we are persuaded that it is unnecessary to formally put the construction notifications out for public comment as interested parties currently have the ability to comment on or oppose such filings.

for a license area, the license will be deemed to have terminated automatically as of the applicable performance benchmark deadline without further Commission action.

IV. SECOND REPORT AND ORDER IN IB DOCKET NO. 95-91

225. In this *Second Report and Order*, we adopt a framework for the regulation of SDARS terrestrial repeaters. First, we adopt technical rules governing the operation of SDARS repeaters that will not unduly constrain the deployment of SDARS repeaters, but that will, at the same time, limit the potential for harmful interference to adjacent WCS spectrum users. Second, we adopt a blanket-licensing regime to facilitate the flexible deployment of SDARS repeaters, which are necessary to ensure a high-quality service to the public, while ensuring that such repeater operations comply with the Commission's rules regarding RF safety, antenna marking and lighting, and equipment authorization, as well as with international agreements. Finally, we address other issues regarding SDARS repeater operations that are not associated with the interference concerns raised by WCS licensees. Specifically, we adopt rules to ensure that SDARS repeaters remain truly complementary to a satellite-based service, and that SDARS terrestrial repeaters are not used to transmit local programming or advertising.

A. Terrestrial Repeater Power and Out-of-Band Emissions Limits

1. Power Limits

226. *Background.* In the *2007 Notice*, the Commission invited comment on three proposals for power limits for SDARS terrestrial repeaters and WCS transmitting stations. One proposal, from Sirius, is to limit ground-level emission levels. The second, proposed by WCS licensees, is to limit average EIRP and the ratio between average and peak EIRP. The third proposal is a hybrid of the ground-level emission limit and the average EIRP limit. We discuss each of these proposals in more detail below.

227. In its *2006 Petition for Rulemaking*, Sirius asserted that the Commission could limit interference between SDARS repeaters and WCS stations by establishing a "ground-level emission limit" of -44 dBm for both SDARS terrestrial repeaters and WCS stations.⁵³⁰ To verify compliance, Sirius proposed that the received power from either an SDARS repeater or a WCS base station would be measured at a height of 2 meters above ground level, at a distance from the base of the antenna that is equal to or greater than the effective height above ground level of the SDARS or WCS station's antenna.⁵³¹ Additionally, under Sirius' proposal, the average power received at a distance of 1 meter from a transmitting WCS subscriber station's antenna would also be limited to -44 dBm.⁵³²

⁵³⁰ *2006 Petition for Rulemaking* at 4-5, cited in *2007 Notice*, 22 FCC Rcd at 22129 ¶ 15. XM and Sirius have referred to the proposed "ground-level emission limit" as a PFD limit. See also Letter from Carl R. Frank, Counsel for XM/Sirius, to Marlene H. Dortch, Secretary, FCC (dated Aug. 14, 2006) at 1; Letter from Patrick L. Donnelly, Executive Vice President, General Counsel, and Secretary, Sirius, and James S. Blitz, Vice President and Regulatory Counsel, XM Radio Inc., to Marlene H. Dortch, Secretary, FCC (dated Sept. 19, 2007) at 7-8 and Annex 2. In the *2007 Notice*, however, the Commission explained that the ground-level emission limit is actually a received power limit (similar to the limits on incidental radiator emissions in Section 15.209 of the Commission's Rules, 47 C.F.R. § 15.209). The Commission explained further that a rule incorporating Sirius' basic idea could be expressed as an equivalent PFD or electric field strength limit. Assuming a 0-dBi measurement antenna (as Sirius does), the -44 dBm received power limit is equivalent to a PFD limit of -45.3 dBW/m² or a field strength limit of 100.5 dBµV/m. *2007 Notice*, 22 FCC Rcd at 22129 n.42.

⁵³¹ See *2006 Sirius Petition for Rulemaking*, Appendices A, proposed Section 25.214(d)(2)(A)(i) and B, proposed Section 27.50(a)(1)(A), cited in *2007 Notice*, 22 FCC Rcd at 22129 ¶ 15.

⁵³² See *2006 Sirius Petition for Rulemaking*, Appendix B, proposed Section 27.50(a)(1)(C), cited in *2007 Notice*, 22 FCC Rcd at 22129 ¶ 15. SDARS subscriber units are receivers only and do not transmit, therefore, there is no similar provision applicable for SDARS.

228. The *2007 Notice* invited interested parties to discuss whether a ground-level emission limit of the kind proposed by Sirius would facilitate deployment of both SDARS and WCS services.⁵³³ Specifically, interested parties were invited to discuss the interference potential of a -44 dBm limit on WCS and SDARS operations and to balance that potential with the economic and business impact of such a limit on WCS and SDARS operations.⁵³⁴ In addition, the *2007 Notice* sought comment on how easy it would be to verify compliance with, and to resolve disputes arising under a ground-level emission limit requirement.⁵³⁵

229. The *2007 Notice* also invited parties to propose alternative ground-level emission limits and encouraged them to provide technical studies demonstrating the effect such alternative limits would have on the ability of SDARS and WCS licensees to serve the public.⁵³⁶ Further, the *2007 Notice* stated that it would consider an equivalent PFD limit expressed in dBW/m², or field strength limit expressed in dB μ V/m, because these alternative measurements would eliminate the need to make an assumption about receiver antenna gain.⁵³⁷ The *2007 Notice* also asked parties to recommend the bandwidth to be used in calculation of a PFD limit if the Commission were to adopt such a limit.⁵³⁸

230. As an alternative to Sirius' ground-level emission limit proposal, WCS licensees proposed allowing SDARS repeaters to operate up to 2 -kW EIRP, based on average rather than peak power, per 5 megahertz, with a 6 dB PAPR.⁵³⁹ The WCS licensees further proposed a power spectral density limit such that only 400-W average EIRP could be emitted per 1 megahertz, to ensure the transmitted energy is spread across the band.⁵⁴⁰

231. In the *2007 Notice*, the Commission asked several questions regarding the WCS Coalition's proposal and the methodology on which it is based.⁵⁴¹ For example, the *2007 Notice* asked whether the adoption of a 2-kW EIRP average power limit would permit the deployment of SDARS services. It also asked whether the adoption of an average rather than a peak power limit for SDARS stations would have any effect on the ability of the licensees to deploy their services. Finally, the *2007 Notice* requested that parties discuss whether an average, rather than peak, power limit would increase the risk of interference with adjacent channel licensees such as WCS or SDARS licensees, or licensees outside of the 2305-2360 MHz band. It also invited comment on whether to adopt the 6 dB PAPR suggested by the WCS Coalition, or whether a different PAPR would be appropriate.⁵⁴² As an alternative, the Commission noted that it adopted a PAPR of 13 dB for wireless services in the 700 MHz band.⁵⁴³

⁵³³ *2007 Notice*, 22 FCC Rcd at 22130 ¶ 18.

⁵³⁴ *2007 Notice*, 22 FCC Rcd at 22130 ¶ 18.

⁵³⁵ *2007 Notice*, 22 FCC Rcd at 22130 ¶ 18.

⁵³⁶ *2007 Notice*, 22 FCC Rcd at 22130 ¶ 18.

⁵³⁷ *2007 Notice*, 22 FCC Rcd at 22130 ¶ 18.

⁵³⁸ *2007 Notice*, 22 FCC Rcd at 22130 ¶ 18.

⁵³⁹ WCS July 9, 2007, *Ex Parte* at 3-4, cited in *2007 Notice*, 22 FCC Rcd at 22131 ¶ 21. As proposed by the WCS Coalition, average EIRP would be calculated using the average power of the transmitter measured in accordance with the definition of "mean power" in Section 2.1 of the Commission's rules.

⁵⁴⁰ WCS July 9, 2007 *Ex Parte*, Appendix A, proposed Sections 27.50(a)(1) and 25.XX(a), cited in *2007 Notice*, 22 FCC Rcd at 22131 ¶ 21.

⁵⁴¹ *2007 Notice*, 22 FCC Rcd at 22131 ¶ 22.

⁵⁴² *2007 Notice*, 22 FCC Rcd at 22131 ¶ 22.

⁵⁴³ *2007 Notice*, 22 FCC Rcd at 22131 ¶ 22, citing *700 MHz Report and Order*, 22 FCC Rcd at 8103-04 ¶¶ 105-06.

232. The *2007 Notice* further noted that the National Association of Broadcasters (NAB) had previously proposed a power limit of 1-kW equivalent radiated power (ERP) for SDARS repeaters, which corresponds to 1.640-kW EIRP. NAB contends this limit is necessary to ensure that the repeaters are used solely to fill in coverage in limited areas where the satellite signal cannot be received. The *2007 Notice* invited comment on NAB's proposal as an alternative to the proposed 2 kW limit discussed above, and requested that such comments be supported with a technical analysis and a realistic assessment of the impact of this limit on all relevant services.⁵⁴⁴

233. Finally, the *2007 Notice* invited interested parties to discuss whether a hybrid power approach might be appropriate. The Commission explained that such an approach would give SDARS licensees flexibility to place their repeaters on high towers and operate them with more power if they meet a certain emission limit on the ground, while WCS would have the flexibility to meet an average EIRP limit using towers lower to the ground.⁵⁴⁵ The *2007 Notice* observed that the Commission adopted a similar approach for the lower 700 MHz band, where commercial base stations must meet an ERP limit of 1 or 2 kW, depending on whether they are deployed in rural areas, but such stations could also transmit at 50-kW ERP if they do not produce signals exceeding a PFD of 3 mW/m² on the ground within 1 km of the station.⁵⁴⁶ Further, the *2007 Notice* invited suggestions regarding specific power limits to be used in a hybrid approach if such an approach is adopted.⁵⁴⁷

234. After review of the comments received in response to the *2007 Notice*, staff evaluated the various proposals for establishing power limits for SDARS terrestrial repeaters. As a result of this review, the *WCS/SDARS Technical Rules Public Notice* proposed to limit SDARS terrestrial repeaters to 12 kW EIRP with a maximum PAPR of 13 dB.⁵⁴⁸

235. *Position of the Parties.* In their comments, the SDARS licensees have continued to advocate ground-level emission limits as one of the appropriate metrics for SDARS terrestrial repeater power limits.⁵⁴⁹ Specifically, Sirius XM advocates a maximum permissible average EIRP of 12 kW for its terrestrial repeaters, and a field strength limit of 100 dB μ V/m, measured 1.5 meters above the ground, to be exceeded at no more than 5 percent of locations within a specified test area, for each of its repeaters.⁵⁵⁰ Sirius XM has proposed a detailed procedure for a predictive analysis that could be used to show that a new terrestrial repeater would satisfy the field strength requirements.⁵⁵¹ Sirius XM points out that WCS receivers operating in the WCS C and D blocks benefit from 4-megahertz guard bands that separate the edges of the C and D blocks from the terrestrial repeater signals.⁵⁵² Sirius XM also proposes

⁵⁴⁴ *2007 Notice*, 22 FCC Rcd at 22131-32 ¶ 23.

⁵⁴⁵ *2007 Notice*, 22 FCC Rcd at 22131-32 ¶ 23.

⁵⁴⁶ *2007 Notice*, 22 FCC Rcd at 22132 ¶ 23, citing 47 C.F.R. §§27.50(c), 27.55(b).

⁵⁴⁷ *2007 Notice*, 22 FCC Rcd at 22132 ¶ 23.

⁵⁴⁸ *WCS/SDARS Technical Rules Public Notice*, Appendix A, proposed rule 25.214(d). The proposed rules would also permit the operation of SDARS terrestrial repeaters at power levels higher than 12 kW EIRP, unless notified by a "potentially affected WCS licensee" that it intends to provide commercial service within the following 365 days. *Id.* We address possible operations of SDARS repeaters above 12 kW EIRP in the discussion of a grandfathering/transition period in Part IV.A.3. below.

⁵⁴⁹ See, e.g., Sirius Comments at 25-31; XM Radio Comments at 21-27.

⁵⁵⁰ Sirius XM Sept. 8, 2008, *Ex Parte* at 17.

⁵⁵¹ Sirius XM Sept. 10, 2008, *Ex Parte*, Exhibit D at 2-3.

⁵⁵² Sirius XM Oct. 2, 2008, *Ex Parte*, Attachment at 2. Sirius XM claims these guard bands consist of the band segment occupied by the satellite signals, which are very low in power as compared to the terrestrial repeater signals in the vicinity of a terrestrial repeater.

a PAPR of 13 dB for its terrestrial repeaters, to be exceeded no more than 0.1 percent of the time based on the complementary cumulative distribution function (CCDF) of the signal measured at the transmitter output.⁵⁵³

236. The WCS Coalition advocates a maximum average EIRP limit of 2 kW for both SDARS terrestrial repeaters and WCS base stations.⁵⁵⁴ The WCS Coalition also advocates a PAPR of 13 dB for SDARS repeaters.⁵⁵⁵ Motorola asserts that the average power criterion for a signal with non-constant envelope modulation avoids the problem of short-duration peaks in signal power placing unnecessary limits on the operating power of base stations and SDARS repeaters.⁵⁵⁶ Motorola also supports the WCS Coalition's proposal to specify the power limit as a power spectral density limit.⁵⁵⁷ The WCS Coalition states that based on testing of WiMAX prototype receivers by NextWave, it believes the receivers of its user devices will suffer from overload interference from SDARS terrestrial repeaters at a received undesired signal level of -44 dBm,⁵⁵⁸ not the -35 dBm overload threshold assumed by Sirius.⁵⁵⁹ The WCS Coalition is also concerned that WCS base stations will suffer overload interference from SDARS terrestrial repeaters' signals that may be sufficiently attenuated by clutter two meters above ground level (so they meet the ground-level emission limit proposed by Sirius XM), but are not sufficiently attenuated at the height of the WCS base stations' receiving antennas.⁵⁶⁰ The WCS Coalition objects to the field strength limits proposed by Sirius XM, stating that a limit of 110 dB μ V/m⁵⁶¹ measured near ground level could result in field strength levels as high as 140 dB μ V/m at the receiving antennas of its base stations.⁵⁶²

237. To protect WCS base station receivers 30 meters above ground level – which WCS licensees believe to be a reasonable compromise for the purpose of establishing a rule – the WCS Coalition states that SDARS terrestrial repeaters should be limited to a field strength of 104 dB μ V/m, the level at which a WCS C or D-block base station receiver will overload, measured at 30 meters above ground level (which converts to a receiver overload interference level of approximately -40 dBm).⁵⁶³ The WCS Coalition also states that an SDARS repeater field strength limit of 64 dB μ V/m, measured 2 meters above the ground (for an approximately -80.6 dBm receiver overload interference level), would fully protect WCS deployment plans.⁵⁶⁴ In addition, the WCS Coalition contends that the Commission should

⁵⁵³ Sirius XM Sept. 10, 2008, *Ex Parte*, Exhibit D at 2.

⁵⁵⁴ WCS Coalition July 22, 2008, *Ex Parte* at 3, Exhibit A at 3. Motorola also supports adoption of a 2 kW-average EIRP limit for SDARS terrestrial repeaters. *See* Motorola Comments at 4-5.

⁵⁵⁵ WCS Coalition Comments at 24.

⁵⁵⁶ Motorola Comments at 4-5.

⁵⁵⁷ Motorola Comments at 5.

⁵⁵⁸ WCS Coalition Reply Comments at 25.

⁵⁵⁹ Sirius Comments at 30.

⁵⁶⁰ WCS Coalition Comments at 33.

⁵⁶¹ Sirius XM proposed the 110 dB μ V/m field strength limit be met in 99 percent of the locations in a defined test area, and the 100 dB μ V/m field strength limit be met in 95 percent of the locations in the test area. Sirius XM September 8, 2008, *Ex Parte* at 17.

⁵⁶² Letter from Paul J. Sinderbrand, Counsel to the WCS Coalition, to Marlene H. Dortch, Secretary, FCC (May 5, 2008), Attachment at 8) (“WCS Coalition May 5, 2008, *Ex Parte*”).

⁵⁶³ WCS Coalition Reply Comments at 28-29.

⁵⁶⁴ WCS Coalition May 5, 2008, *Ex Parte*, Attachment at 10.

mandate that SDARS terrestrial repeaters be operated between 2324.2 and 2341.285 MHz so that Sirius or XM will not be able to move transmissions closer in frequency to the WCS frequency bands edges, which the WCS Coalition contends could worsen potential interference to WCS operations.⁵⁶⁵ Also, the WCS Coalition argues that a ground-level field strength limit without an EIRP component is a very poor predictor of interference to WCS,⁵⁶⁶ and that limiting EIRP is the best available mechanism for assuring that WCS and SDARS can provide viable service offerings in their spectrum allocations.⁵⁶⁷

238. In reply, Sirius contends that the WCS Coalition fails to provide any information about the performance of WCS mobile or base station receivers and provides very little evidence to support the large zones of interference to WCS operations that the WCS Coalition contends would be caused by SDARS terrestrial repeaters. Furthermore, Sirius argues that even a limited use of antenna down-tilt by the WCS licensees could significantly reduce the actual zones of interference to “inconsequential” sizes.⁵⁶⁸ In addition, XM contends that the WCS Coalition has disregarded the availability of band-pass filters that would provide an additional 10 to 20 dB of protection to mitigate interference.⁵⁶⁹

239. In response to the *WCS/SDARS Technical Rules Public Notice*, Sirius XM and the WCS Coalition have stated that the proposal to limit SDARS repeaters to a 12-kW EIRP power level with a maximum PAPR of 13 dB is a generally acceptable compromise.⁵⁷⁰

240. *Discussion.* We adopt a power limit of 12 kW average EIRP for SDARS repeaters, with a maximum PAPR of 13 dB.⁵⁷¹ We find that adoption of this power limit balances the objectives of protecting WCS operations from harmful interference and avoiding unnecessary and costly re-configuring of existing SDARS repeater networks, which could degrade service to the public.⁵⁷² We note that both Sirius XM and the WCS Coalition have accepted this power limit for SDARS repeaters.⁵⁷³

⁵⁶⁵ WCS Coalition Comments at 34-35; WCS Comments on *WCS/SDARS Technical Rules Public Notice* at 16 (filed April 23, 2010).

⁵⁶⁶ WCS Coalition Reply Comments at 26.

⁵⁶⁷ WCS Coalition Reply Comments at 27.

⁵⁶⁸ Sirius Reply Comments at 32-33.

⁵⁶⁹ XM Reply Comments at 37.

⁵⁷⁰ Comments of Sirius XM Radio Inc. at 36 (filed April 23, 2010) (stating that the proposed 12-kW average EIRP and 13-dB peak to average power ratio limits are generally acceptable for most situations); Comments of the WCS Coalition at 12 (filed April 23, 2010) (stating that, although the WCS community would prefer to see SDARS repeaters' power limits set at 2-kW EIRP, it is prepared to adapt to SDARS repeaters operating at up to 12-kW (average) EIRP).

⁵⁷¹ The peak-to-average power ratio (PAPR) measurements must be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that the PAPR will not exceed 13 dB for more than 0.1 percent of the time or another Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission. *See infra*, Appendix B, Section 25.144(e)(7)(ii).

⁵⁷² We also note that Industry Canada has imposed a similar maximum power limit of 12.5 kW average EIRP on SDARS repeater operations in Canada. *See* Industry Canada, Spectrum Management and Telecommunications, Broadcasting Procedures and Rules, *Part 9: Application Procedures and Rules for Terrestrial S-DARS Undertakings (Satellite Digital Audio Radio Service)*, BPR-9, Issue 2 (January 2009), available online at <http://www.ic.gc.ca/epic/site/smt-gst.nsf/en/sf08569e.html> (last visited April 27, 2010).

⁵⁷³ *See supra.*, n.570.

241. Based on our evaluation of the record before us and the experience gained in this and other proceedings involving advanced wireless communications, we find that SDARS repeaters operating up to 12-kW average EIRP and a maximum PAPR of 13 dB will not cause substantially more interference to actual WCS operations than repeaters operating at 2-kW average EIRP – the power limit proposed by the WCS Coalition. In reaching this finding, we calculate that with a 2-kW average EIRP and a maximum PAPR of 13 dB for the repeaters, coupled with the WCS mobile receiver overload interference threshold of -44 dBm claimed by the WCS licensees, SDARS terrestrial repeaters would have to be separated from WCS mobile receivers by a distance of 328 meters to avoid overload interference the WCS mobile receivers. If SDARS repeaters operate at 12-kW average EIRP, with a 13-dB maximum PAPR, and a WCS receiver overload interference threshold of -35 dBm is assumed (as suggested by the SDARS licensees), the separation distance necessary to avoid overload interference from SDARS terrestrial repeaters and WCS mobile receivers is calculated to be approximately 300 meters. We also note that the AWS testing showed that the receiver overload interference improves with increased frequency separation.⁵⁷⁴ Thus, the approximately 300-meters separation distance calculated using a 12-kW average EIRP, a maximum PAPR of 13 dB, a -35 dBm receiver overload interference threshold, as suggested by Sirius XM, and no frequency separation is an upper bound on the separation distance. Because the nearest WCS bands (Blocks C and D) are located approximately four megahertz from an SDARS terrestrial repeater band, we expect that the separation distance will, in most cases, be significantly less than the 300 meters. Thus, the interference environment from SDARS repeaters operating at 12 kW average EIRP (with a 13 dB maximum PAPR) is no worse than that posed by SDARS repeaters operating at 2-kW average EIRP, assuming that the overload interference threshold of WCS mobile receivers is -35 dBm. We therefore conclude that adopting a power limit of 12-kW average EIRP, with a maximum PAPR of 13 dB, for SDARS terrestrial repeater operations will not unduly impair operations of WCS mobile receivers.

242. We find that adoption of a power limit of 12-kW average EIRP (with a maximum PAPR of 13 dB) for SDARS terrestrial repeaters will not unduly impair the ability of WCS licensees to provide mobile broadband services. The WCS Coalition does not object to the 12-kW level proposed in the April 2, 2010 *WCS/SDARS Technical Rules Public Notice*.⁵⁷⁵ WCS licensees can initially deploy currently available equipment and request that manufacturers design and produce WCS mobile devices with more robust receiver overload interference tolerance (*i.e.*, a level) that is better than -44 dBm.

243. We also conclude that SDARS terrestrial repeaters can operate at an average EIRP of 12 kW with a maximum PAPR of 13 dB without causing harmful interference to WCS base station receivers. The WCS Coalition assumes that such base stations will operate with an overload interference level of -40 dBm.⁵⁷⁶ As in the case of the WCS mobile receivers, however, we believe that because the WCS is in its early stages of deployment, WCS licensees can request that manufacturers design and produce WCS base stations with more robust overload interference thresholds. The ability to provide more robust overload interference protection for base stations is supported by the fact that base stations will not be as numerous as mobile devices and that they are not subject to the same size and cost restraints as consumer mobile devices. An improved receiver overload interference threshold, combined with judicious WCS base station site selection and receiving antenna down-tilting, would substantially reduce the potential for SDARS terrestrial repeaters to cause harmful interference to WCS base station receivers.

⁵⁷⁴ See Advanced Wireless Service Interference Test Results and Analysis, Federal Communications Commission Office of Engineering and Technology, at 11 (rel. Oct. 10, 2008), available at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-08-2245A2.pdf.

⁵⁷⁵ See Comments of the WCS Coalition at 12 (filed April 23, 2010).

⁵⁷⁶ See WCS Coalition Comments in response to 2007 Notice at n.106.

244. Our adoption of a 12-kW average EIRP (with a maximum PAPR of 13 dB) for SDARS terrestrial repeaters is consistent with our goal of reducing the potential for harmful interference to WCS to negligible levels, and avoiding unnecessary and costly re-configuring of existing SDARS repeater networks, which could degrade service to the public. The Commission has previously found that terrestrial repeaters are needed to overcome multipath interference and signal blockage inherent to the satellite radio service,⁵⁷⁷ and has permitted SDARS repeater networks to be constructed pursuant to grants of special temporary authority while rules governing their long-term operations were being developed. We do not expect there to be a significant change in the make-up of the SDARS repeater networks, since the SDARS licensees have built out their networks substantially pursuant to grants of STAs. By permitting an average EIRP level of 12 kW and a 13-dB maximum PAPR, we find that SDARS licensees would not need to power down a large number of the existing terrestrial repeaters and supplement them with substantial numbers of lower-power repeaters in order to maintain or improve the provision of a high-quality service.

245. We will not adopt a rule restricting the operation of SDARS terrestrial repeaters to between 2324.2 and 2341.285 MHz, as the WCS Coalition requests.⁵⁷⁸ We believe this to be unnecessary. SDARS terrestrial repeaters already operate at least four megahertz from the edges of the WCS frequency bands. Given the large deployed infrastructure of SDARS satellites, terrestrial repeaters, and consumer receivers – all designed for the current SDARS licensees' band plans – we conclude that a rule requiring SDARS repeater operations to stay within their existing band plans is not needed.⁵⁷⁹

246. We do not adopt the other proposals for power limits on SDARS terrestrial repeaters. In particular, we decline to adopt the ground-level emission limit proposal of Sirius because of the difficulties associated with characterizing and quantifying the case-specific propagation environment's effects on an RF signal's field strength that could influence the interference potential at each terrestrial repeater site. As the WCS Coalition contends,⁵⁸⁰ a ground-level signal strength limit is not a reliable predictor of harmful interference. Because of the variety of obstructions close to the ground that could significantly attenuate a RF signal's field strength, the actual signal strength experienced by WCS base station or user equipment receivers would, in many cases, be greater than the signal strength predicted at ground-level. Furthermore, the rules that would result from an attempt to deal with the anomalies associated with field strength levels would be overly complex and difficult for licensees to comply with and would be difficult, at best, for the Commission to enforce.

247. We also decline to adopt the 1-kW ERP limit on SDARS repeater power, which NAB states is necessary in order to ensure that the repeaters are used solely to fill in coverage in limited areas where the satellite signal cannot be received. The restrictions adopted below prohibiting the use of SDARS repeaters to originate local programming and advertising and establishing eligibility criteria for operating SDARS repeaters will ensure that use of SDARS repeaters remains complementary to a satellite-delivered service.⁵⁸¹ In addition, the substantial expense of deploying repeaters is a substantial deterrent against deploying them in areas where satellite signals can be adequately received.

⁵⁷⁷ See *SDARS Order and FNPRM*, 12 FCC Rcd at 5810 ¶ 138.

⁵⁷⁸ Comments of the WCS Coalition at 16 (filed April 23, 2010).

⁵⁷⁹ We note that Sirius XM states that such re-deployment is purely hypothetical at the moment, since it would take “many years before Sirius XM could even consider relocating its satellite downlink band” given the “tens of millions of satellite radio receivers currently installed in late model cars and trucks.” Comments of Sirius XM Radio Inc. at 7 (filed May 13, 2010).

⁵⁸⁰ WCS Coalition Reply Comments at 26.

⁵⁸¹ See *infra*, Section IV.B.4 and C.1.

2. Out-of-Band Emissions Limits

248. *Background.* In the *2007 Notice*, the Commission sought comment on whether it should require OOBE from SDARS repeaters to be attenuated by a factor of not less than $75 + 10 \log (P)$ dB, or whether some other OOBE limit would be more appropriate.⁵⁸² Comments were received from both Sirius XM and WCS Coalition on this issue. The WCS Coalition supports the proposal of the *2007 Notice*.⁵⁸³ Sirius XM is willing to accept a stricter OOBE attenuation factor of $90 + 10 \log (P)$ dB in a 1-megahertz resolution bandwidth for SDARS terrestrial repeaters.⁵⁸⁴ Sirius XM, however, continues to support an OOBE attenuation factor of $75 + 10 \log (P)$ dB for SDARS terrestrial repeaters operating with an EIRP of 2 W or less.⁵⁸⁵

249. *Discussion.* We adopt the stricter out-of-band emission limits agreed to by Sirius XM for terrestrial repeaters operating at power levels greater than 2-W average EIRP. Thus, such repeaters will be required to attenuate their OOBE by a factor not less than $90 + 10 \log (P)$ dB over a 1-megahertz resolution bandwidth. We believe that such terrestrial repeater OOBE attenuation levels will provide WCS licensees sufficient protection from interference under almost all operating conditions and provide SDARS licensees with achievable limits that can reasonably be attained with limited impact on system capacity. SDARS licensees indicate that their repeaters are already capable of meeting this stricter limit,⁵⁸⁶ and stricter OOBE limits are always preferable where economically and technically feasible.

250. We adopt the proposal to require repeaters operating at power levels of 2 W or less average EIRP to attenuate their OOBE by a factor not less than $75 + 10 \log (P)$ dB over a 1-megahertz resolution bandwidth. Sirius XM supports this proposal. Such devices are likely to be small in size and used to increase SDARS signal strength inside of buildings. We find that this lower level of attenuation is warranted for this class of repeaters, since walls, ceilings, and other materials will limit the range of indoor transmissions and the number of potentially affected WCS stations will also be limited.

3. Grandfathering/Transition Period

251. *Background.* The SDARS licensees have deployed terrestrial repeaters pursuant to grants of special temporary authority from the International Bureau. As the Bureau explained in its orders first authorizing the terrestrial repeater networks in 2001, the grant of STA to operate such repeaters served the public interest because the SDARS licensees were ready to commence commercial service, but no rules were in place to govern the operations of terrestrial repeaters necessary to complete the SDARS network.⁵⁸⁷ Some of these STAs authorized the operation of terrestrial repeaters up to 40 kW EIRP. The International Bureau included explicit statements in its grants of STA that any actions taken under the

⁵⁸² *2007 Notice*, 22 FCC Rcd at 22138 ¶ 25.

⁵⁸³ WCS Coalition July 22, 2008, *Ex Parte*, Exhibit A at 3 (proposing a draft rule requiring SDARS repeater OOBE to be attenuated by a factor not less than $75 + 10 \log (P)$ dB outside of the SDARS frequency bands)

⁵⁸⁴ Sirius XM Sept. 10, 2008, *Ex Parte*, Exhibit D at 2.

⁵⁸⁵ Sirius XM Sept. 10, 2008, *Ex Parte*, Exhibit D at 5.

⁵⁸⁶ See Sirius Reply Comments at Appendix B to Exhibit A at 15 (“As previously indicated all Sirius current repeaters (including, specifically, the ones used in the WCS Coalition prediction) meet an OOBE limit of $90+10\log (P)$ (1MHz BW)...”). See also XM Reply Comments at 39 (“Based on the specifications XM provides to equipment manufacturers, current XM equipment attenuates [OOBE] by a factor of approximately $90 + 10*\log (P)$ dB.”).

⁵⁸⁷ See generally *Sirius 2001 STA Order*, 16 FCC Rcd 16773; *XM 2001 STA Order*.

STAs are “solely at [the licensee’s] own risk,” and that the grant of the STAs “shall not prejudice the outcome of any final repeater rules adopted by the Commission.”⁵⁸⁸

252. Sirius proposes to exempt, or “grandfather,” SDARS terrestrial repeaters from the rules adopted in this proceeding, if those repeaters were deployed before those rules take effect.⁵⁸⁹ The 2007 Notice invited comment on Sirius’ proposal. In particular, the Commission invited SDARS licensees and WCS licensees to discuss the specific economic and technical difficulties they would face if currently deployed repeaters are or are not grandfathered.⁵⁹⁰ It also requested comment on whether the Commission should adopt a limit or cutoff point at which a particular repeater will not be eligible for grandfathering, or whether any grandfathering measure should be limited to the authorized parameters of the SDARS licensees’ repeater STAs.⁵⁹¹

253. The 2007 Notice also requested comment on the best transition period for the existing SDARS terrestrial repeaters, in the event that it does not grandfather those repeaters.⁵⁹² It asked if the Commission should adopt the same transition period for all repeaters, or whether it should permit each repeater to continue its existing operations until a WCS licensee requests the SDARS licensee to bring that repeater into compliance with the rules adopted here.⁵⁹³ Commenters were encouraged to provide quantitative analysis and technical studies in support of their comments.⁵⁹⁴

254. Sirius XM supports grandfathering of currently deployed repeaters, particularly if the Commission were to adopt the WCS Coalition proposal to limit terrestrial repeater power levels to 2 kW average EIRP. According to the Sirius XM, complying with such a limit would require it to install many new repeaters,⁵⁹⁵ would cause disruption to existing service,⁵⁹⁶ and would increase the likelihood of interference to WCS licensees.⁵⁹⁷ For example, XM contends that it would need to introduce 39 new repeaters in the Indianapolis market to comply with an average EIRP limit of 2 kW and maintain existing service coverage and quality.⁵⁹⁸ Sirius XM also argues that it will face unreasonable costs to re-configure their existing repeater networks, absent grandfathering. It estimates that the equipment and construction costs, site leases, utilities, and maintenance for each site, if it must comply with this limit, could amount to tens of millions of dollars.⁵⁹⁹ XM also notes that each site would require 12 to 18 months for approval

⁵⁸⁸ See, e.g., *Sirius 2001 STA Order*, 16 FCC Rcd at 16779 ¶ 18; *XM Radio 2001 STA Order*, 16 FCC Rcd at 16787 ¶ 18. Since 2001, both Sirius and XM have submitted additional STA requests to modify their repeater networks or to add new repeaters. See *2007 Notice*, 22 FCC Rcd at 22127 ¶ 11. Many of those STA requests have been granted, and all the STAs that have been granted were subject to conditions substantially similar to the conditions included in the 2001 STAs. A full list of SDARS STA requests are available through the International Bureau Filing System (IBFS), which is available online at <http://licensing.fcc.gov/myibfs/>

⁵⁸⁹ See *2006 Petition for Rulemaking* at 6, cited in *2007 Notice*, 22 FCC Rcd at 22135 ¶ 33.

⁵⁹⁰ *2007 Notice*, 22 FCC Rcd at 22136 ¶ 35.

⁵⁹¹ *2007 Notice*, 22 FCC Rcd at 22136 ¶ 35.

⁵⁹² *2007 Notice*, 22 FCC Rcd at 22136 ¶ 36.

⁵⁹³ *2007 Notice*, 22 FCC Rcd at 22136 ¶ 36.

⁵⁹⁴ *2007 Notice*, 22 FCC Rcd at 22136 ¶ 36.

⁵⁹⁵ XM Comments at 25-26.

⁵⁹⁶ Sirius Comments at 36.

⁵⁹⁷ Sirius Reply Comments at 33-34.

⁵⁹⁸ XM Comments at 26.

⁵⁹⁹ Sirius Comments at 36; XM Comments at 27; Sirius Reply Comments at 34.

and construction,⁶⁰⁰ and asks at a minimum that, if the Commission does not grandfather its existing repeaters, that it be given adequate time to come into compliance with the new rules.⁶⁰¹

255. The WCS Coalition opposes grandfathering, and recommends that all repeaters be brought into compliance with any new rules within a year of adoption.⁶⁰² As the WCS Coalition points out, the STAs were expressly conditioned on compliance with any SDARS repeater rules that may be adopted.⁶⁰³ The WCS Coalition further contends that when the SDARS operators deployed their repeater networks pursuant to grants of special temporary authority, they accepted the risk that they would incur costs in bringing their repeaters into compliance with future rules.⁶⁰⁴ Finally, the WCS Coalition argues that developing a different set of rules for new and grandfathered repeaters would be confusing and difficult to administer.⁶⁰⁵ However, the WCS Coalition has stated that it was willing to accept a scenario where the SDARS operators could operate existing repeaters “so long as those operations continue to be subject to the current absolute obligation to cure interference that might occur in the future to WCS operations.”⁶⁰⁶

256. The WCS Coalition also criticizes XM and Sirius for deploying a number of repeaters that did not comply with the technical parameters authorized pursuant to their grants of STA.⁶⁰⁷ The WCS Coalition contends that greater scrutiny is required before grandfathering should be extended to such repeaters.⁶⁰⁸

257. *Discussion.* We decline to adopt the grandfathering proposal proposed by Sirius. Instead, we require terrestrial repeaters to be operated according to the power limits and out-of-band emissions attenuation requirements adopted today in any area in which a WCS licensee would be “potentially affected” and the potentially affected WCS licensee provides written notice to Sirius XM that it intends to commence commercial service within the following 365 days. Sirius XM will have 180 days from the date of this written notice to conform all repeaters in the area to the 12-kW average power limit (with a maximum 13-dB PAPR) and out-of-band emissions attenuation requirements adopted for terrestrial repeater operations. Until a WCS licensee so notifies Sirius XM and the 180-day period to conform operations has passed, Sirius XM may operate terrestrial repeaters above these power limits or with out-of-band emissions attenuation levels less than those established herein on an unprotected, non-harmful interference basis with respect to all permanently authorized radiocommunication facilities.

258. We have previously concluded that the public interest is served by establishing power limits and out-of-band emissions attenuation requirements for SDARS terrestrial repeater operations.⁶⁰⁹

⁶⁰⁰ XM Comments at 26.

⁶⁰¹ XM Reply Comments at 40-41.

⁶⁰² WCS Coalition Comments at 41-42.

⁶⁰³ WCS Coalition Comments at 47, citing *Sirius 2001 STA Order*, 16 FCC Rcd at 16777; *XM Radio 2001 STA Order*, 16 FCC Rcd at 16787.

⁶⁰⁴ WCS Coalition Comments at 48-49; WCS Coalition Reply Comments at 48.

⁶⁰⁵ WCS Coalition Comments at 49-50.

⁶⁰⁶ WCS Coalition July 22, 2008, *Ex Parte* at 3. See also WCS Coalition May 5, 2008, *Ex Parte*, Attachment at 7.

⁶⁰⁷ WCS Coalition Reply Comments at 45-46, 49. WCS Coalition July 22, 2008, *Ex Parte* at 3-4.

⁶⁰⁸ WCS Coalition Reply Comments at 46. *But see* WCS Coalition July 22, 2008, *Ex Parte* at 3-4 (noting that the WCS Coalition takes no position as to whether the Commission should make a distinction between “grandfathering” illegally constructed repeaters and those operations pursuant to the parameters of an STA.)

⁶⁰⁹ See *supra*, Section IV.A.1 and 2.

We found that these power limits and out-of-band emissions attenuation requirements balance the objective of protecting WCS operations from harmful interference with a desire to avoid costly re-configuring of existing SDARS repeater networks, which could degrade existing service to the public. Allowing SDARS repeaters to operate above these power limits or with lesser out-of-band emissions attenuation levels in areas where WCS licensees provide service would upset this balance. Accordingly, we find that Sirius' proposal to permanently exempt all currently deployed terrestrial repeaters from the rules we adopt today is not in the public interest, since there would be no requirement for such repeaters to conform to the power limits and out-of-band emissions attenuation requirements adopted in this proceeding. Although Sirius XM states that grandfathering is necessary to protect its investment in existing repeater facilities, it had no reasonable expectation that repeaters built pursuant to STAs would be able to continue to operate indefinitely, since the STAs explicitly state that any actions taken under the STAs were solely at Sirius XM's own risk, and that the grant of the STAs would not prejudice the outcome of any final repeater rules adopted by the Commission.

259. We conclude, however, that the purpose of the power limits and out-of-band emissions attenuation requirements is not undermined by allowing SDARS repeaters to operate at power levels higher than 12 kW average EIRP, or with out-of-band emissions attenuation levels less than those established herein, in areas where WCS facilities are not providing service. The adoption of power limits and out-of-band emissions attenuation levels facilitates the introduction of WCS services in areas where both SDARS and WCS seek to provide service to the public. There may be areas, however, in which Sirius XM desires to operate repeaters, but in which no WCS licensees provide commercial service. If no WCS licensees are providing commercial service in such areas, there is no public interest in prohibiting SDARS repeaters from operating at power levels greater than 12-kW average EIRP, or operating with out-of-band emissions attenuation levels less than those specified herein.

260. Because WCS is not yet widely deployed, we conclude that the public interest is not served by requiring all SDARS terrestrial repeaters to meet power limits and out-of-band emission attenuation requirements upon the effective date of this Second Report and Order.⁶¹⁰ Instead, SDARS repeaters may be operated at levels greater than 12-kW average EIRP, or with lesser out-of-band emission attenuation levels, until Sirius XM is notified in writing by a potentially affected WCS licensee that it has commenced commercial service already, or that it intends to commence commercial service within 365 days following the notice. This requirement is intended to restrict notice to only those areas where WCS licensees have already commenced commercial service or have immediate plans to commence commercial service, thus discouraging WCS licensees from simply sending notices for all areas that they have licenses to operate, regardless of the timeframe in which service is contemplated in a particular area. WCS licensees can provide this written notice at any time after the effective date of the rules adopted in this Second Report and Order. Sirius XM will then have 180 days from the date it receives the written notice to bring all repeaters in the area into compliance with the 12-kW average EIRP power limit and the out-of-band emissions attenuation requirements adopted today. This 180-day period balances the need for WCS licensees to commence commercial service expeditiously with the goal of avoiding unnecessary and costly re-configuring of existing SDARS repeater networks, which could degrade existing service to the public. Sirius XM may continue to operate repeaters previously authorized under STA – or to operate new or modified repeaters – above the power limits or with lesser out-of-band emissions attenuation levels than those specified herein, in areas for which it does not receive written notice from potentially affected WCS licensees. In these situations, however, operations of such repeaters shall be on a non-interference basis with respect to all permanently authorized radiocommunication facilities.

⁶¹⁰ We note that repeater operations that do not comply with the power and out-of-band emissions limits adopted herein are not eligible for blanket licensing, but must instead be licensed on a site-by-site basis. See *infra*, Section IV.B.1.

261. For purposes of establishing whether a notifying WCS licensee is “potentially affected” by a SDARS terrestrial repeater operating above the power limits or with lesser out-of-band emissions attenuation levels than those set for such repeater operations, we will use a definition similar to the definition of “potentially affected WCS licensee” set forth in the notification and information sharing requirements that we adopt herein.⁶¹¹ Accordingly, a notifying WCS licensee is “potentially affected” by SDARS terrestrial repeater operating above the power limits or with lesser out-of-band emissions attenuation levels than those set for such repeater operations if it is authorized to operate a base station in the 2305-2315 MHz or 2350-2360 MHz bands in the same Major Economic Area (MEA) as that in which the terrestrial repeater is located, or is authorized to operate a base station in the 2315-2320 MHz or 2345-2350 MHz bands in the same Regional Economic Area Grouping (REAG) as that in which the terrestrial repeater is located. In addition, a notifying WCS licensee is potentially affected if a SDARS terrestrial repeater operating above the power limits or with lesser out-of-band emissions attenuation levels than those established herein for such repeater operations is located within 5 kilometers of the boundary of an MEA or REAG in which the notifying WCS licensee is authorized to operate a WCS base station.

262. We decline to adopt the alternate definition of “potentially affected WCS licensee” proposed by Sirius XM. Sirius XM argues that the definition of “potentially affected” that we adopt today is overbroad, because REAGs are large service areas and may require Sirius XM to modify repeater operations far outside of areas in which the WCS licensee intends to commence commercial service.⁶¹² Instead, Sirius XM urges adoption of a proximity-based approach – rather than a market approach based on the market of the notifying WCS licensee – and proposes a distance of 5 km between an SDARS repeater and a planned WCS base station before a WCS licensee is “potentially affected” by the repeater.⁶¹³ Sirius XM does not, however, provide an engineering basis for its proposed 5-km distance, and the record does not provide sufficient evidence for establishing a proximity-based approach. Furthermore, the approach based on the WCS licensing market we adopt today provides greater regulatory certainty to SDARS and WCS licensees of which repeaters would be required to modify operations in light of imminent WCS commercial deployments and is easier to administer. Although the approach based on licensing market may over-include the number of repeaters that need to be modified, this is consistent with the public interest in having as many SDARS repeaters as possible authorized through a blanket license according to the power level and OOB standards adopted today. These standards are the most effective means of ensuring coexistence of SDARS and WCS operations in the 2.3 GHz band, and we prefer to err on the side of over-inclusion.

263. We also decline to require “potentially affected” WCS licensees to post with the Commission, as part of the notification process, a performance bond that would be forfeited if the WCS licensee does not actually commence commercial operations within 365 days of the notification.⁶¹⁴ Although there may be instances where WCS licensees do not commence commercial operations within this 365-day period, we do not expect bad faith on the part of the notifying WCS licensee to be the reason for the failure to commence on time. We observe that, in the event that the notifying WCS licensee subsequently fails to provide service in the notified area, or ceases to provide such service at a future date, Sirius XM may seek a waiver of the power and OOB standards adopted today to permit operations on specific repeaters above 12-kW average EIRP or with lower OOB attenuation levels.

⁶¹¹ See *infra*, Appendix B, at § 25.263(b)(1).

⁶¹² Sirius XM Comments at 38-40 (filed April 23, 2010). As an example, Sirius XM states that a WCS licensee planning to commence service in San Diego, California could require Sirius XM to modify the operation of a terrestrial repeaters outside Seattle, Washington, well over 1,000 miles away. *Id.* at 39.

⁶¹³ *Id.* at 39-40.

⁶¹⁴ *Id.* at 40.

264. In order to effect an orderly transition from operations under grants of STA to permanent authority to operate terrestrial repeaters, we instruct the International Bureau to extend all existing grants of STA for SDARS repeaters for a period of 180 days from the release date of this *Second Report and Order*.⁶¹⁵ We also instruct the International Bureau to grant all requests for STA to operate repeaters pending at the time this *Second Report and Order* is released.⁶¹⁶ We stress, however, that any operations granted pursuant to a pending STA must be comply with the 12-kW EIRP limit and OOB attenuation standards within 180 days of notice that a potentially affected WCS license has already commenced commercial service, or intends to commence commercial service with the 365 days following the notice. In order that Sirius XM may continue to adjust its repeater network to meet subscriber needs, the International Bureau may continue to grant STAs for new or modified repeaters in the period between the release of this *Second Report and Order* and the date that any permanent authorization to operate SDARS repeaters becomes effective. Any grant of STA to operate terrestrial repeaters shall terminate automatically on the day that permanent authority to operate the covered repeater operations becomes effective, without the need for further action by the International Bureau.

265. We note that the WCS concern regarding unauthorized operation of SDARS terrestrial repeaters not in compliance with the terms of STAs was addressed in the context of the Consent Decrees XM and Sirius reached with the Enforcement Bureau.⁶¹⁷ Furthermore, the adoption of permanent rules governing SDARS repeater operations will result in the eventual termination of operations of repeaters pursuant to STAs. Because we are not exempting repeaters operating under grants of STA from the rules we adopt today, compliance with the terms of prior grants of authority under STA will not affect the interference environment in any areas where WCS licensees commence service to the public.

B. Licensing Regime for Terrestrial Repeaters

1. Blanket Licensing Regime

266. *Background.* In the *1997 Further Notice*, the Commission sought comment on allowing SDARS licensees to deploy an unlimited number of terrestrial repeaters under a single authorization, based on a demonstration that all the repeaters will comply with the Commission's rules.⁶¹⁸ The *1997 Further Notice* did not specify the format of such a demonstration, or whether the authorization should be in the form of a modification to the licensee's space station authorization or through some other procedural vehicle.⁶¹⁹

267. In its *2006 Petition for Rulemaking*, Sirius proposed that the Commission allow SDARS licensees to construct and operate an unlimited number of terrestrial repeaters under their existing SDARS

⁶¹⁵ In the event blanket licenses are not issued within 180 days of the effective date of this Order, SDARS licensees may file applications to extend the STAs for an additional 180 days, or until blanket licenses to operate SDARS repeaters are granted, whichever comes first.

⁶¹⁶ We note that that operation of all repeaters under grants of STA are on a non-interference basis with respect to all permanently authorized radiocommunication facilities. In light of the rules adopted today, this non-interference condition shall not apply to repeaters operating at 12-kW average EIRP or less, with a maximum 13-dB PAPR, since the Commission has already found such operations to be in the public interest.

⁶¹⁷ See Sirius Satellite Radio Inc., *Order*, FCC 08-176 (rel. Aug. 5, 2008) ("*Sirius Consent Decree Order*"), *XM Radio, Inc.*, *Order*, FCC 08-177 (rel. Aug. 5, 2008) ("*XM Consent Decree Order*").

⁶¹⁸ See *1997 Further Notice*, 12 FCC Rcd at 5812 ¶ 142, 5845 (App. C); *cited in 2007 Notice*, 22 FCC Rcd at 22138 ¶ 45.

⁶¹⁹ *2007 Notice*, 22 FCC Rcd at 22138 ¶ 45.

space station authorizations, so long as the repeaters meet all applicable Commission rules.⁶²⁰ In other words, under Sirius' proposal, the holder of a valid SDARS space station license would not need any additional authorization or prior approval for operation of terrestrial repeaters.⁶²¹ Sirius further proposed allowing SDARS licensees to retain repeater authority indefinitely, as long as the licensee maintains a valid space station license.⁶²² In response, the WCS Coalition did not oppose blanket licensing of SDARS repeaters *per se*, although it opposed many of the rules that Sirius proposed to govern operation of such repeaters.⁶²³

268. The 2007 Notice invited comment on Sirius' blanket licensing proposal.⁶²⁴ It also invited comment on adopting a licensing procedure for SDARS repeaters like that prescribed for large networks of very small aperture terminals (VSATs) in the Fixed-Satellite Service (FSS).⁶²⁵ Under the VSAT licensing procedure, the operator applies for an earth station license to operate up to a specific number of remote terminals during a specific license term.⁶²⁶ In addition, the 2007 Notice invited comment on using an alternative licensing procedure patterned on the procedure for licensing Mobile Satellite Service (MSS) ancillary terrestrial components (ATCs) to operate in spectrum assigned for MSS operations by FCC-licensed space stations, whereby the MSS licensee applies for modification of its space station license.⁶²⁷

269. XM argues that blanket licensing is an efficient method for authorizing new facilities and supports unlimited blanket licensing for repeaters under an SDARS space station license.⁶²⁸ Sirius contends that applying for authority for each repeater individually is cumbersome.⁶²⁹ Sirius stresses that authority for WCS operation is granted by blanket licensing and maintains that blanket licensing should also be available for SDARS repeaters.⁶³⁰

270. *Discussion.* We conclude that SDARS licensees should be able to obtain blanket licenses for terrestrial repeaters that operate in compliance with the rules governing such operation. The Commission issues blanket licenses for earth stations in VSAT networks,⁶³¹ for subscriber mobile devices in MSS networks,⁶³² and for the ancillary terrestrial component (ATC) to MSS networks.⁶³³ In those

⁶²⁰ 2006 Petition for Rulemaking, Appendix A, proposed Section 25.214(d)(1); cited in 2007 Notice, 22 FCC Rcd at 22139 ¶ 46.

⁶²¹ 2007 Notice, 22 FCC Rcd at 22139 ¶ 46.

⁶²² *Id.*

⁶²³ WCS Coalition July 2007 Letter at 1 n.3; cited in 2007 Notice, 22 FCC Rcd at 22139 ¶ 46. The WCS Coalition opposed many of the rules proposed by Sirius for operation of such repeaters, such as, among other things, the proposal to operate repeaters at power levels greater than 2 kW average EIRP.

⁶²⁴ 2007 Notice, 22 FCC Rcd at 22139 ¶ 47.

⁶²⁵ 2007 Notice, 22 FCC Rcd at 22139 ¶ 47.

⁶²⁶ 2007 Notice, 22 FCC Rcd at 22139 ¶ 47, citing 47 C.F.R. § 25.134(d).

⁶²⁷ 2007 Notice, 22 FCC Rcd at 22139 ¶ 47, citing 47 C.F.R. § 25.149.

⁶²⁸ XM Comments at 41.

⁶²⁹ Sirius Comments at 7-8.

⁶³⁰ Sirius Comments at 9.

⁶³¹ See 47 C.F.R. § 25.134.

⁶³² See 47 C.F.R. §§ 25.135 and 25.136.

⁶³³ See 47 C.F.R. § 25.149.

contexts, the Commission has found that blanket licensing is an efficient mechanism for issuing large numbers of authorizations. There is nothing in the record that would warrant precluding SDARS operators from obtaining blanket licenses for their terrestrial repeaters.

271. Our adoption of blanket licensing does not mean that SDARS licensees will be permitted to deploy an unlimited number of terrestrial repeaters. SDARS licensees must specify, as part of their blanket license application, the maximum number of terrestrial repeaters that they propose to operate at power levels greater than 2 W, and the maximum number that they propose to operate at power level of 2 W or less. The Commission retains discretion to determine, when reviewing such applications, whether allowing operation of the proposed maximum numbers of repeaters would be consistent with the public interest. Operation of repeaters in excess of the number specified in the blanket license application would constitute a violation of the license terms and subject the licensee to possible action by the Enforcement Bureau.

272. For purposes of blanket licensing, we adopt a model based on our licensing of VSAT networks. To obtain authority for terrestrial repeaters, SDARS licensees must file an earth station application using Form 312, except that a Schedule B need not be filed since this form asks for technical information that is either inapplicable to SDARS terrestrial repeater operations or immaterial to determining whether such operations would serve the public interest. The application must also specify the maximum number of repeaters that will be deployed under the authorization at 1) power levels equal to or less than 2 W average EIRP, and 2) power levels greater than 2-W average EIRP (up to 12-kW average EIRP). The application must also identify the space station(s) with which the terrestrial repeaters will communicate, the frequencies and emission designations of such communications, and the frequencies and emission designations used to re-transmit the received signals. The application must include a certification that the proposed SDARS terrestrial repeater operations will comply with all the rules adopted for such operations.⁶³⁴ The fees associated with SDARS terrestrial repeater filings shall be those associated with filings for FSS VSAT systems in Section 1.1107 of the Commission's rules.⁶³⁵

273. We conclude the blanket-licensing is inappropriate for repeater operations that do not comply with the rules adopted for SDARS terrestrial repeater operations. Such non-compliant operations may not be applied for, or authorized under, the same blanket authorization as compliant repeater operations. Rather, the operation of such non-compliant repeaters must be applied for and authorized under individual site-by-site licenses using Form 312, and appropriate waiver of the Commission's rules must be requested for non-compliant operations. For example, individual site-by-site licensing will apply to any SDARS terrestrial repeaters that are proposed to operate at power levels greater than 12 kW average EIRP (with a maximum PAPR of 13 dB), that do not comply with applicable OOB attenuation levels, that do not comply with the requirements of Part 1, Subpart I, and Part 17, or that do not meet the requirements of all applicable international agreements. For each such repeater, the application for an individual site-by-site license must contain, as an attachment to the application, the technical information required to be shared with WCS licensees as part of the notification requirements adopted herein.⁶³⁶ Earth station applications for SDARS terrestrial repeaters, under either a blanket or site-by-site approach, will be subject to the Commission's existing rules regarding public notice prior to agency action, which will provide a procedure for interested parties to comment on the contents of specific applications.

⁶³⁴ See *infra*, Appendix B, § 25.144(e)(8)(iii).

⁶³⁵ 47 C.F.R. § 1.1107.

⁶³⁶ See *infra*, Appendix B, § 25.144(c)(9).

274. The license term for such repeater operations will be the same as for SDARS space stations, *i.e.*, 8 years.⁶³⁷ Authorization to operate such repeaters will terminate automatically, however, in the event that programming retransmitted by the repeaters is not also being transmitted by satellite directly to an SDARS licensee's subscribers' receivers. As discussed below, it is our intent that terrestrial repeaters be used solely to simultaneously re-transmit the complete programming, and only that programming, that is also being transmitted by satellite directly to an SDARS licensee's subscribers' receivers, and may not be used to distribute any information not also transmitted to all subscribers' receivers.⁶³⁸ If, during the term of the blanket license for repeater operations, the complete programming re-transmitted by repeaters is not also being transmitted by satellite directly to an SDARS licensee's subscribers' receivers, repeaters must cease operations until such time as the complete programming is being transmitted directly to that SDARS licensee's subscribers' receivers.

275. We decline to adopt a licensing procedure modeled on that used for ATC operations. MSS licensees with FCC-licensed space stations request authority for ATC operation by seeking modification of their space station authorizations. Although SDARS licensees have operated terrestrial repeaters pursuant to grants of space station STAs, it is not in the public interest to continue to use space station authorizations as the vehicle for licensing SDARS terrestrial repeaters. As discussed below, repeater operations are not tied to specific SDARS space stations, and we have concluded that it is permissible for repeaters to re-transmit signals from sources other than SDARS space stations.⁶³⁹ As a result, it is administratively difficult to tie repeaters to a specific space station authorization, since some repeaters may not be communicating with any SDARS space station.⁶⁴⁰ Nor is there any need to do so in order to prevent SDARS repeaters from operating as stand-alone facilities, since we determine below that repeaters, regardless of the source of programming origination, are limited to re-transmitting the complete programming, and only that programming, that is also being transmitted by satellite directly to SDARS subscribers' receivers.⁶⁴¹

2. Notification Requirements

276. *Background.* As discussed above in Section III.E.5., we proposed requiring WCS and SDARS licensees to notify potentially affected licensees in the other service prior to deploying new or modified WCS base stations or SDARS terrestrial repeaters. As a result of these proposals, we have adopted rules requiring WCS licensees to provide informational notifications, as set forth in new Section 27.72 in Appendix B.⁶⁴² In addition, WCS licensees must share with SDARS licensees certain technical information at least 10 business days before operating a new base station, and at least 5 business days before operating a modified base station.⁶⁴³ All WCS licensees and WCS spectrum lessees must also

⁶³⁷ See *infra*, Appendix B, § 25.121. See also 47 C.F.R. § 25.145(d) ("The license term for each digital audio radio service satellite shall commence when the satellite is launched and put into operation and the term will run for eight years.")

⁶³⁸ See *infra*, Section IV.C.1.

⁶³⁹ See *infra*, Section IV.B.4 (concluding that the use of non-SDARS satellites to feed programming to terrestrial repeaters is reasonable and technically-justified).

⁶⁴⁰ See *id.* (observing that Sirius provides programming to its terrestrial repeaters through leased capacity on third-party FSS space stations, not directly through its SDARS space station).

⁶⁴¹ See *infra*, Section IV.C.1.

⁶⁴² See *supra*, paragraph 146. For the sake of brevity, we will not repeat the background and discussion underlying the adoption of these proposed rules here, but rather incorporate these background and discussion sections by reference.

⁶⁴³ *Id.*

provide Sirius XM an inventory of their deployed infrastructure in accordance with and within 30 days of the effective date of new Section 27.72 in Appendix B to this Order.⁶⁴⁴ Although this information need not be provided to the Commission when it is provided to SDARS licensees, a WCS licensee must maintain an accurate and up-to-date inventory of its base stations, including the information set forth in Section 27.72(c)(2), which shall be made available upon request by the Commission.⁶⁴⁵

277. *Discussion.* We adopt parallel requirements for SDARS licensees to notify potentially affected WCS licensees prior to deployment of new or modified SDARS terrestrial repeaters. Our review of the record indicates that the potential for interference between an SDARS repeater and a WCS base station can be mitigated by a streamlined notification process, whereby the SDARS licensees share information regarding new or modified SDARS repeater operations. Specifically, as set forth in new Section 25.263 in Appendix B, we will require SDARS licensees to provide informational notifications as specified in those rules.⁶⁴⁶ The rules we adopt today will require SDARS licensees to share with WCS licensees certain technical information at least 10 business days before operating a new repeater, and at least 5 business days before operating a modified repeater.⁶⁴⁷

278. In order to facilitate the efficient planning of robust WCS future network deployments, we also require SDARS licensees to provide potentially affected WCS licensees an inventory of their terrestrial repeater infrastructure, including the information set forth in Section 25.263 for each repeater currently deployed. Although we do not require this information to be routinely provided to the Commission when it is provided to WCS licensees, an SDARS licensee operating terrestrial repeaters must maintain an accurate and up-to-date inventory of its terrestrial repeaters operating above 2 W EIRP, including the information set forth in Section 25.263(c)(2) for each repeater, which shall be made available to the Commission upon request.⁶⁴⁸ An SDARS licensee may satisfy this requirement, for example, by maintaining this information on a secure website, which can be accessed by authorized Commission staff at any time.

279. WCS and SDARS licensees are required to cooperate in good faith in the selection and use of new or modified station sites and frequencies to reduce interference and make the most effective use of the authorized facilities. Licensees suffering or causing harmful interference must cooperate in good faith to resolve such problems by mutually satisfactory arrangements. If the licensees are unable to do so, the International Bureau, in consultation with the Office of Engineering and Technology and the Wireless Telecommunications Bureau, may impose restrictions, including specifying transmitter power, antenna height, and area or hours of operation of a station. Similarly, the Wireless Telecommunications

⁶⁴⁴ *Id.*

⁶⁴⁵ *Id.*

⁶⁴⁶ We note that if a WCS licensee is party to a *de facto* transfer spectrum leasing arrangement under Part 1, Subpart X of the Commission's rules, its lessee will be required to comply with new Section 25.263, in Appendix B to this Order.

⁶⁴⁷ Specifically, SDARS licensees must share technical information with potentially affected WCS licensees. For these purposes, "potentially affected" is defined in Section 25.263(b)(1) of the Commission's rules as set forth in Appendix B to this Order. Potentially affected WCS licensees include those licenses authorized to operate base stations in the same Major Economic Area (MEA) or Regional Economic Area Grouping (REAG) as that in which the terrestrial repeater is to be located. In addition, in cases in which a terrestrial repeater is to be located within 5 km of the boarder of an MEA or REAG, the SDARS licensee must provide information to WCS licensees authorized to operate base stations in that neighboring MEA or REAG. There is nothing in the record to suggest that an SDARS repeater greater than 5 km from an MEA or REAG boarder is likely to cause harmful interference to a WCS base station in a neighboring MEA or REAG.

⁶⁴⁸ *See infra*, Appendix B at § 25.263(c)(2).

Bureau, in consultation with the Office of Engineering and Technology and the International Bureau, may impose such restrictions on WCS licensees.

3. Collocation of SDARS and WCS Stations

280. In the *2007 Second Further Notice*, the Commission observed that Sirius proposed requiring SDARS licensees planning to collocate a terrestrial repeater with a WCS base station or another SDARS licensee's terrestrial repeater to demonstrate that the collocation would not cause more harmful interference than a single repeater at that location.⁶⁴⁹ Sirius also proposed a similar rule for WCS licensees planning to collocate with SDARS licensees or other WCS licensees.⁶⁵⁰ Alternatively, the WCS Coalition maintained that a coordination requirement would be sufficient, and that no specific collocation requirements are needed.⁶⁵¹

281. The *2007 Notice* sought comment on the need for collocation rules in general, and for Sirius' proposal in particular. It also invited parties to propose an adequate showing that collocation will not increase aggregate interference. In addition, it invited comment on mechanisms for dispute resolution if parties are unable to agree on a particular showing. Finally, it asked whether the use of multiple sectorized antennas on SDARS repeaters ameliorates or exacerbates collocation concerns. Commenters were encouraged to support their positions on this issue with detailed technical studies.⁶⁵²

282. XM maintains that SDARS operators and WCS licensees can resolve interference issues between themselves in coordination, and asserts that restrictions on collocation are unneeded.⁶⁵³ Similarly, the WCS Coalition asserts that the Commission typically relies on licensees to work out collocation issues privately, and that complex collocation rules are unnecessary for SDARS and WCS base station facilities.⁶⁵⁴

283. *Discussion.* We agree that specific collocation rules are not required. We are adopting a notification procedure that will substantially reduce the probability that SDARS and WCS will cause harmful interference to each other. If SDARS operators and WCS licensees can agree to collocate facilities, we see no public interest benefit in precluding them from doing so.

4. Eligibility to Operate Terrestrial Repeaters

a. Use of Repeaters with Non-SDARS Satellites

284. *Background.* The *2007 Notice* sought comment on a proposal to prohibit the stand-alone operation of SDARS repeaters by requiring the repeaters to transmit only in conjunction with an operating SDARS satellite.⁶⁵⁵ The Commission reasoned that such a requirement would ensure that SDARS repeaters are used to complement the end-user satellite service, and so would be consistent with the

⁶⁴⁹ See *2007 Second Further Notice*, 22 FCC Rcd at 22123 ¶ 26.

⁶⁵⁰ See *2007 Second Further Notice*, 22 FCC Rcd at 22123 ¶ 26.

⁶⁵¹ See *2007 Second Further Notice*, 22 FCC Rcd at 22123 ¶ 27.

⁶⁵² See *2007 Notice*, 22 FCC Rcd at 22123 ¶ 28.

⁶⁵³ XM Comments at 38-39.

⁶⁵⁴ WCS Coalition Comments at 35-37.

⁶⁵⁵ *2007 Notice*, 22 FCC Rcd at 22139 ¶ 48, citing *SDARS Order and FNPRM*, 12 FCC Rcd at 5811 ¶ 139; *2001 Public Notice* at 3.

frequency allocation for SDARS. It also stated that such a requirement would ensure that there would be no transformation of SDARS into an independent terrestrial network.⁶⁵⁶

285. The 2007 Notice also invited comment on whether SDARS licensees may use non-SDARS satellites to feed terrestrial repeaters.⁶⁵⁷ For example, Sirius currently uses FSS VSAT networks to send to its SDARS repeaters the exact same programming that is sent from Sirius through its SDARS satellites to subscribers.⁶⁵⁸ Sirius states that this distribution method is necessary to avoid self-interference, or “ring around,” which would otherwise be caused by the collocation of a receiver and transmit antenna on the same repeater using adjacent frequencies.⁶⁵⁹ Sirius contends that placing restrictions on its use of repeaters would preclude SDARS licensees from using those repeaters efficiently.⁶⁶⁰ NAB opposes the use of non-SDARS satellites to feed repeaters, arguing that the elimination of a requirement that repeaters be fed from a SDARS satellite paves the way for terrestrial repeaters to act independently from the satellite-based network.⁶⁶¹

286. *Discussion.* We adopt the requirement that only entities holding or controlling SDARS space station licenses may construct and operate SDARS repeaters and only in conjunction with at least one SDARS space station that is concurrently authorized and transmitting directly to subscribers. We conclude that such a requirement is important in ensuring that SDARS repeaters remain complementary to a satellite-based service and that SDARS repeaters are not transformed into terrestrial broadcast network independent of the satellite-based service for which the 2320-2345 MHz band was allocated. We also note the requirement, adopted in Section IV.C.1 *supra*, that SDARS terrestrial repeaters are restricted to the simultaneous retransmission of the complete programming, and only that programming, transmitted by the satellite directly to the SDARS subscribers' receivers, and may not be used to distribute any information not also transmitted to all subscribers' receivers.⁶⁶² Under such eligibility and programming requirements, the operation of SDARS repeaters depends on the operation of the SDARS satellites. Unless SDARS licensees have operational satellites, there will be no programming transmitted via satellite directly to any SDARS subscriber's receiver. In situations where there are no operational SDARS satellites, we prohibit the associated repeaters from transmitting as well.⁶⁶³ Thus, this requirement prohibits stand-alone operation of terrestrial repeaters, absent operational SDARS satellites providing service directly the public. Accordingly, if the same programming provided by terrestrial repeaters is not also being provided to subscriber receivers directly from SDARS satellites, terrestrial

⁶⁵⁶ *SDARS Order and FNPRM*, 12 FCC Rcd at 5811 ¶ 139.

⁶⁵⁷ *2007 Notice*, 22 FCC Rcd at 22139-22140 ¶ 49.

⁶⁵⁸ *2007 Notice*, 22 FCC Rcd at 22139-22140 ¶ 49. Sirius explains that each repeater is co-located with a VSAT antenna, which receives transmissions in the Ku-band (11.7-12.2 GHz space-to-Earth) via a FSS satellite in geostationary orbit. The repeater converts the Ku-band signal into S-band (2.3 GHz-band) frequencies used for SDARS repeater transmissions. *See id.*

⁶⁵⁹ *2007 Notice*, 22 FCC Rcd at 22139-22140 ¶ 49. Unlike XM Radio, which has divided its center terrestrial repeater spectrum into two equal segments, Sirius operates with a single center repeater segment. Sirius' system design will not permit its SDARS repeaters to receive a satellite signal from one of its outer segments of its assigned band and re-transmit it in the center segment without generating self-interference into channels dedicated to subscriber reception. *Id.* at n.131.

⁶⁶⁰ Sirius Comments at 37.

⁶⁶¹ *2007 Notice*, 22 FCC Rcd at 22140 ¶ 49. *See also* NAB Comments at 5-6.

⁶⁶² *See infra* Section IV.C.1.

⁶⁶³ We do not intend for this rule, however, to prohibit SDARS repeaters from operating during limited service outages on SDARS satellites, where at least one SDARS satellite remains operational and transmitting directly to some portion of the public.

repeaters must cease operations until such time as the complete programming is restored and is transmitted directly to SDARS licensee's subscribers' receivers.

287. We also find that it is not necessary to feed SDARS repeaters directly through SDARS satellites. Under the facts presented by Sirius, we conclude that the use of non-SDARS satellites to feed repeaters is a reasonable and technically-justified method to avoid self-interference. We emphasize that, so long as the repeaters are restricted to the simultaneous retransmission of the complete programming, and only that programming, transmitted by the satellite directly to the SDARS subscribers' receivers, and are not used to distribute any information not also transmitted to all subscribers' receivers, the policy objectives of the Commission regarding the appropriate use of SDARS terrestrial repeaters are met.⁶⁶⁴

b. Use of Repeaters Outside of SDARS Satellite Service Area

288. The *2007 Notice* sought comment on whether we should adopt rules governing the ability of SDARS licensees to deploy repeaters in geographic areas not within the service footprint of SDARS satellites and the impact a prohibition on such terrestrial repeater deployments would have on the ability of the American public residing in areas not within the service footprint of SDARS satellites to receive satellite radio.⁶⁶⁵ The *2007 Notice* observed that Sirius had filed requests for special temporary authority to operate terrestrial repeaters in Alaska and Hawaii, where it is difficult to receive a signal directly from the Sirius satellites.⁶⁶⁶ Sirius asserts that restricting its use of repeaters in this fashion would preclude SDARS licensees from extending service to unserved areas.⁶⁶⁷ Sirius further maintains that using repeaters to extend service to new areas is the same as using them to extend service to urban canyons and heavily foliated areas.⁶⁶⁸ NAB and the broadcasters' associations of Alaska and Hawaii oppose such operations, arguing that the repeaters in this instance are not complementary to a satellite service, but are rather stand-alone terrestrial facilities.⁶⁶⁹ They also contend that allowing SDARS licensees to use their repeaters in this manner would harm localism in broadcasting.⁶⁷⁰ We note that, as part of our review of the merger between Sirius and XM, numerous parties called for equal provision of SDARS to all consumers in the United States, regardless of their places of residence.⁶⁷¹ Although we found in that proceeding that expanded SDARS satellite coverage beyond the conterminous United States is not technically feasible or economically reasonable at this time,⁶⁷² we strongly encouraged service to Alaska, Hawaii, the U.S. Virgin Islands and other territories of the United States, where technically feasible and

⁶⁶⁴ See *infra*, Section IV.C.1.

⁶⁶⁵ *2007 Notice*, 22 FCC Rcd at 22140 ¶¶ 50-51.

⁶⁶⁶ *2007 Notice*, 22 FCC Rcd at 22140 ¶ 50, citing Sirius Satellite Radio Inc., *Request for Special Temporary Authority to Operate Four Satellite DARS Terrestrial Repeaters in Alaska and Hawaii*, IBFS File No. SAT-STA-20061107-00131, filed Nov. 11, 2006. In this Order below, we conclude that SDARS licensees should be allowed to provide service to Alaska and Hawaii, through the use of terrestrial repeaters. Since none of the requested repeaters are proposed to be operated at power levels greater than 12-kW average EIRP, we instruct the International Bureau to grant Sirius' pending application to operate terrestrial repeaters in Alaska and Hawaii as part of the framework for transition from STAs to blanket licensing adopted in Section IV.A.3 above.

⁶⁶⁷ Sirius Comments at 37-38.

⁶⁶⁸ Sirius Reply at 37-38.

⁶⁶⁹ *2007 Notice*, 22 FCC Rcd at 22140 ¶ 50. See also NAB Comments at 7-10; Alaska/Hawaii Broadcasters Comments at 3, 5.

⁶⁷⁰ Alaska/Hawaii Broadcasters Comments at 3-5.

⁶⁷¹ See *SDARS Merger Order*, 23 FCC Rcd at 12416 ¶ 148 and n.484.

⁶⁷² See *SDARS Merger Order*, 23 FCC Rcd at 12417-18 ¶150.

economically reasonable to do so.⁶⁷³ We also found in that proceeding that the public interest would be served through a voluntary commitment by the merger applicants to provide the Sirius satellite radio service to the Commonwealth of Puerto Rico using terrestrial repeaters.⁶⁷⁴

289. *Discussion.* We find that the public interest favors the ability of SDARS licensees to operate terrestrial repeaters in Alaska, Hawaii, and other U.S. Territories and Possessions that are not within the service footprint of SDARS satellites. We confirm that use of terrestrial repeaters is a technically and economically feasible way to expand SDARS service to residents of Alaska, Hawaii, and U.S. Territories and Possessions. The Commission has previously stated its commitment to supporting a vibrant and vital terrestrial radio service for the public.⁶⁷⁵ Each time that the Commission has considered the impact of SDARS on terrestrial radio service, it has found insufficient evidence that SDARS necessarily harms the viability of local broadcasters or their ability to air locally oriented programming.⁶⁷⁶ We also find unconvincing the argument that operation of SDARS repeaters in areas not also served through a SDARS satellite footprint transforms the repeaters into stand-alone terrestrial broadcast stations, because the repeaters will not be transmitting content that is different from the content supplied to subscribers in the conterminous United States via satellite. Accordingly, repeaters in Puerto Rico, Alaska, Hawaii, and U.S. Territories and Possessions can be included as part of an application for blanket authority to operate terrestrial repeaters.

5. SDARS Environmental Impact and RF Safety

a. Environmental Assessment

290. *Background.* Section 1.1307(b) of the Commission's rules requires almost all Commission licensees to prepare an Environmental Assessment (EA) if a particular facility, operation, or transmitter would cause human exposure to levels of RF fields in excess of certain specified limits.⁶⁷⁷ For licensees subject to Part 25 and transmitting in frequency bands above 1,500 MHz, those limits are 5 mW/cm² averaged over six minutes for the licensee's employees, provided those employees are “fully aware of the potential for exposure and can exercise control over their exposure,” and 1 mW/cm² averaged over 30 minutes for the general population.⁶⁷⁸ For terrestrial cellular and paging services, the radiated power limit for categorical exclusion from the requirement to determine compliance with the exposure limits (routine environmental evaluation) and preparation of an EA if the exposure limits are

⁶⁷³ See *SDARS Merger Order*, 23 FCC Rcd at 12416 ¶ 147, 12417-18 ¶ 150.

⁶⁷⁴ See *SDARS Merger Order*, 23 FCC Rcd at 12416 ¶ 147. Subsequent to the merger, Sirius XM applied for – and was granted – STA to operate terrestrial repeaters in the Commonwealth of Puerto Rico. See *Sirius XM Radio Inc., Order and Authorization*, DA 09-2039 (Int'l Bur., Sat. Div. rel. Sept. 11, 2009).

⁶⁷⁵ See *SDARS Order and FNPRM*, 12 FCC Rcd at 5769 ¶ 33.

⁶⁷⁶ See *SDARS Order and FNPRM*, 12 FCC Rcd at 6768 ¶ 31 (“In sum, although healthy satellite DARS systems are likely to have some adverse impact on terrestrial radio audience size, revenue, and profits, the record does not demonstrate that licensing satellite DARS would have such a strong adverse impact that it threatens the provision of local radio service.”); *SDARS Merger Order*, 23 FCC Rcd at 12382-84 ¶¶ 73-74, 12480 ¶ 155 (finding that even when merged, SDARS will not necessarily harm the ability of local broadcasters to air locally oriented programming).

⁶⁷⁷ Section 1.1307(b)(1) of the Commission's rules, 47 C.F.R. § 1.1307(b), *cited in 2007 Notice*, 22 FCC Rcd at 22137-38 ¶¶ 41-42. The exception is “portable equipment” subject to the equipment certification requirement in Section 2.1093 of the Commission's rules, 47 C.F.R. § 2.1093. We discuss equipment certification further below.

⁶⁷⁸ Sections 1.1307(b) and 1.1310 of the Commission's rules, 47 C.F.R. §§ 1.1307(b), 1.1310, *cited in 2007 Notice*, 22 FCC Rcd at 22137-38 ¶¶ 41-42. The Commission has included compliance with these limits as conditions on Sirius’ and XM’s terrestrial repeater STAs. See, e.g., *Sirius 2001 STA Order*, 16 FCC Rcd at 16778 ¶ 16.

exceeded is set at 1,640 W EIRP, or 1,000 W ERP.⁶⁷⁹ The *2001 Public Notice* sought comment on requiring an evaluation and preparation of an EA if limits are exceeded only for SDARS terrestrial repeaters intended to be operated at power levels over 2,000 W EIRP.⁶⁸⁰ In the *2007 Notice*, the Commission observed that Sirius did not address this issue in its petition for rulemaking.⁶⁸¹ The first RF-safety issue that we address in this *Second Report and Order* is the RF level at which we should require SDARS terrestrial repeater licensees to perform a routine environmental evaluation to determine compliance and prepare an EA if the exposure limits are exceeded.

291. *Discussion.* Sirius recommends requiring environmental evaluations for outdoor SDARS repeaters operating at over 1,640 W EIRP, and for indoor repeaters operating at over 2 W EIRP.⁶⁸² According to Sirius, allowing two watts for low power satellite radio repeaters would parallel its recommendations for power limits on fixed WCS subscriber devices and should be sufficient for most in-building satellite radio applications.⁶⁸³ We adopt Sirius' proposal. Sirius' proposed requirement would be consistent with the Commission's proposal in the *2001 Public Notice*.⁶⁸⁴ It is also consistent with the Commission's RF safety requirements for terrestrial cellular and paging services.⁶⁸⁵

b. Blanket Licensing for High-Powered Repeater

292. *Background.* In the *1997 Further Notice*, the Commission proposed to preclude SDARS licensees from deploying any terrestrial repeater pursuant to a blanket license if the repeater requires an EA pursuant to the rules limiting human exposure to RF energy.⁶⁸⁶ In other words, the Commission proposed that authority for operation of SDARS repeaters that would generate cumulative radiation levels in excess of the exposure guidelines in Section 1.1310 would have to be sought by filing an individual license application for each such repeater. In the *2007 Notice*, the Commission observed that Sirius did not address this issue in its petition for rulemaking.⁶⁸⁷ Accordingly, we must determine whether to allow blanket licensing for outdoor SDARS repeaters operating at over 1,640 W EIRP, and for indoor repeaters operating at over 2 W EIRP.

293. *Discussion.* None of the parties filing comment in response to the *2007 Notice* addressed this issue. As discussed above, we decide to adopt a blanket-licensing procedure for SDARS terrestrial repeaters.⁶⁸⁸ We also decide to model this blanket licensing on our licensing provision for VSATs. Applicants seeking blanket licensing for VSATs must demonstrate that the terminals will comply with the

⁶⁷⁹ Section 1.1307(b)(1) of the Commission's rules, 47 C.F.R. § 1.1307(b), *cited in 2007 Notice*, 22 FCC Rcd at 22137-38 ¶¶ 41-42.

⁶⁸⁰ *2001 Public Notice*, 16 FCC Rcd at 19442, *cited in 2007 Notice*, 22 FCC Rcd at 22137-38 ¶¶ 41-42. An EIRP of 2,000 watts is equivalent to an ERP of 1219.5 watts.

⁶⁸¹ *2007 Notice*, 22 FCC Rcd at 22137 ¶ 41.

⁶⁸² Sirius Comments at 11.

⁶⁸³ *Id.*

⁶⁸⁴ *See 2001 Public Notice*, 16 FCC Rcd at 19442, *cited in 2007 Notice*, 22 FCC Rcd at 22137-38 ¶¶ 41-42.

⁶⁸⁵ Section 1.1307(b)(1) of the Commission's rules, 47 C.F.R. § 1.1307(b), *cited in 2007 Notice*, 22 FCC Rcd at 22137-38 ¶¶ 41-42.

⁶⁸⁶ *1997 Further Notice*, 12 FCC Rcd at 5845 (Appendix C), *cited in 2007 Notice*, 22 FCC Rcd at 22137 ¶ 40. *See also* 47 C.F.R. §§ 1.1301-1319.

⁶⁸⁷ *2007 Notice*, 22 FCC Rcd at 22137-38 ¶ 42.

⁶⁸⁸ *See supra*, Section IV.B.1.

Commission's rules regarding environmental impact.⁶⁸⁹ Accordingly, to be consistent with the VSAT blanket licensing provisions, we will require SDARS applicants seeking blanket licensing of terrestrial repeaters to certify that those repeaters will comply with the environmental impact rules. Although we will not require routine submission of a demonstration of compliance with the environmental impact rules as part of a blanket license application to operate terrestrial repeaters, SDARS licensees must maintain demonstrations of compliance with such rules and make such demonstrations available to the Commission upon request within 3 business days.⁶⁹⁰

294. We conclude that a prohibition on blanket-licensed facilities that require an EA, as was proposed in the *2007 Notice*, is not necessary. In addition to specifying the RF level at which an EA is needed, Part 1, Subpart I of the Commission's rules specifies procedures for ensuring that the Commission considers any significant environmental impact that could result from granting any application.⁶⁹¹ Those procedures apply both to individually licensed facilities and to blanket-licensed facilities. There is nothing in the record that would suggest that the RF safety standards and procedures currently in Part 1, Subpart I are insufficient for blanket-licensed facilities. Therefore, we conclude that we need not adopt any additional safeguards against RF exposure from blanket-licensed SDARS terrestrial repeaters, other than the safeguards currently in Part 1, Subpart I.

c. Radio Frequency Safety Requirements for Very Low-Powered Repeaters

295. *Background.* In the *2007 Notice*, the Commission requested comment on whether to adopt any additional RF safety measures for very low power repeaters, 10 W or less, deployed indoors where members of the general public may be present. Specifically, the *2007 Notice* asked whether warning labels or a professional installation requirement might be necessary.⁶⁹²

296. *Discussion.* No comments were received on this proposal. The RF safety rules in Part 1, Subpart I already take into account the need for warning labels or other mitigating factors in cases where a transmitter may have a significant environmental impact.⁶⁹³ The record in this proceeding does not provide any support for adopting additional labeling requirements for SDARS terrestrial repeaters.

6. Compliance with International Agreements

297. *Background.* The *2007 Notice* sought comment regarding SDARS repeater operations and obligations under international agreements between the U.S. Government and the administrations of Canada and Mexico.⁶⁹⁴ The agreements specifically contemplate the use of SDARS repeaters as part of the U.S.-licensed SDARS systems and establish maximum PFD levels for U.S. SDARS repeater

⁶⁸⁹ See 47 C.F.R. Section 25.134(d) (VSAT license applicants must file applications on Form 312, which includes Question 28, requiring the submission of a radiation hazard study).

⁶⁹⁰ See *infra*, Appendix B, at Section 25.263(c)(2).

⁶⁹¹ See, e.g., 47 C.F.R. §§ 1.1307, 1.1308.

⁶⁹² *2007 Notice*, 22 FCC Rcd at 22138 ¶ 43.

⁶⁹³ See 47 C.F.R. § 1.1307(b).

⁶⁹⁴ *2007 Notice*, 22 FCC Rcd at 22136-22137 ¶¶ 37-39, citing Agreement Concerning the Coordination Between U.S. Satellite Digital Audio Radio Service and Canadian Fixed Service and Mobile Aeronautical Telemetry Service in the Band 2320-2345 MHz (Aug. 25, 1998) ("U.S.-Canada Agreement"); Agreement Between the Government of the United States of America and the Government of the United Mexican States Concerning the Use of the 2310-2360 MHz Band (July 24, 200) ("U.S.-Mexico Agreement"). The texts of these agreements are available via the Internet at <http://www.fcc.gov/ib/>.

operations in the vicinity of the U.S.-Mexico and U.S.-Canada borders.⁶⁹⁵ The *2007 Notice* noted a proposal to require prior Commission approval of any SDARS repeater that exceeds the power levels and/or proximity restrictions contained in these international agreements.⁶⁹⁶ It also observed that, as part of its *2006 Petition for Rulemaking*, Sirius proposed to require SDARS repeaters to conform to the terms of the U.S.-Mexico Agreement entered into in 2000 (or any successor agreement), but was silent on whether SDARS repeaters must conform with the agreement between the U.S. and Canada.⁶⁹⁷ The *2007 Notice* sought comment on Sirius' proposal and invited comment on any alternatives that may be appropriate.⁶⁹⁸

298. *Discussion.* We adopt a rule requiring SDARS repeater operations to comply with these agreements.⁶⁹⁹ Sirius and XM do not oppose requiring compliance with the international agreements between the U.S. Government and the administrations of Canada and Mexico.⁷⁰⁰ Should an SDARS licensee wish to operate SDARS repeaters that will not comply with the international agreements with Canada and Mexico (or any successor agreements), it must seek a modification of its blanket license to authorize such repeater operations and must seek a waiver of this rule. An SDARS licensee may not operate repeaters that do not comply with international agreements unless the SDARS licensee has received explicit authority from the Commission to do so.

7. Marking and Lighting of Antenna Structures

299. *Background.* Part 17 of the Commission's rules⁷⁰¹ requires all Commission licensees to comply with Federal Aviation Administration (FAA) requirements regarding the marking and lighting of antenna structures that may become a menace to air navigation.⁷⁰² In the *2007 Notice*, the Commission requested comment on whether SDARS licensees should be required to demonstrate compliance with Part 17 as part of any request for blanket authorization of SDARS terrestrial repeaters.⁷⁰³

300. *Discussion.* XM and Sirius do not oppose the imposition of this requirement.⁷⁰⁴ We see no reason to exempt SDARS repeaters from the Part 17 requirements that are generally applicable to all Commission licensees.⁷⁰⁵ Accordingly, we adopt the proposal from the *2007 Notice* to require SDARS

⁶⁹⁵ See U.S.-Canada Agreement at 5 (coordination of terrestrial repeaters not necessary provided individual repeaters do not exceed PFD limit of -119 dB (W/m²/4kHz) at and beyond common border); U.S.-Mexico Agreement, Appendix I (setting PFD limit for terrestrial repeaters at -154 dB (W/m²/4kHz) at the U.S.-Mexico border). See also *2007 Notice*, 22 FCC Rcd at 22136 ¶ 37.

⁶⁹⁶ *2007 Notice*, 22 FCC Rcd at 22136 ¶ 38.

⁶⁹⁷ *2007 Notice*, 22 FCC Rcd at 22137 ¶ 39.

⁶⁹⁸ *2007 Notice*, 22 FCC Rcd at 22137 ¶ 39.

⁶⁹⁹ We note that this rule is the same as the condition regarding compliance with international agreements that has been placed on all SDARS repeater STAs to date.

⁷⁰⁰ Sirius Comments at 38; XM Comments at 40.

⁷⁰¹ 47 C.F.R. Part 17.

⁷⁰² See 47 C.F.R. § 17.1.

⁷⁰³ *2007 Notice*, 22 FCC Rcd at 22138 ¶ 44.

⁷⁰⁴ XM Comments at 40; Sirius Comments at 10.

⁷⁰⁵ We note that the existing STAs for SDARS repeater condition operations on compliance with Part 17 of the Commission's rules. See, e.g., *Sirius 2001 STA Order*, 12 FCC Rcd at 16780 ¶ 18.

licensees applying for blanket terrestrial repeater authority to certify in their applications that they will comply with the requirements of Part 17.⁷⁰⁶

8. Equipment Authorization

301. *Background.* The Communications Act authorizes the Commission to make regulations to ensure that devices that emit radio-frequency (RF) energy comply with applicable technical rules to ensure that they will not cause harmful interference before they enter the stream of commerce in the United States.⁷⁰⁷ Pursuant to that authority, the Commission has adopted rules that require many types of RF-emitting equipment to be authorized for importation or commercial distribution in accordance with one of three procedures – Certification, Declaration of Conformity, and Verification – which are defined in Part 2 Subpart J of the rules.⁷⁰⁸ Together, these procedures are commonly known as the equipment authorization rules.⁷⁰⁹ The technical standards for equipment authorization vary by device, but today the majority of radio transmitters that "intentionally radiate" radio waves must be found to be compliant with the governing rules before being marketed, sold, or imported into the United States.⁷¹⁰ In particular, the Commission requires Certification of "portable earth station transceivers"⁷¹¹ and ATC transmitters.⁷¹² Under Part 27 of the Commission's rules, WCS transmitters are subject to the Certification procedure contained in the Commission's equipment authorization rules.⁷¹³ In the *2007 Notice*, the Commission questioned whether a Certification requirement should be adopted either for SDARS terrestrial repeaters operating at very low power repeaters or for repeaters operating at higher power levels.⁷¹⁴

302. Sirius supports an equipment authorization process for SDARS terrestrial repeaters that is comparable to the process that has been required for WCS transmitters (*i.e.*, Certification).⁷¹⁵ Sirius XM, however, requests that it be given at least a 24-month long window of time to complete Certification of existing repeaters, or that it be allowed to use a procedure other than Certification – such as Verification

⁷⁰⁶ Sections 25.113(c), (d), and (e) of the Commission's rules, 47 C.F.R. § 25.113(c), (d), (e), state that all Part 25 licensees are subject to Part 17 of the Commission's rules. Because we have decided not to exempt SDARS terrestrial repeater licensees from these requirements, it is not necessary to revise these rules.

⁷⁰⁷ 47 U.S.C. § 302.

⁷⁰⁸ Certification is an equipment authorization issued by the Commission or by a recognized Telecommunication Certification Body (TCB) on behalf of the Commission based on an application and test data submitted by the responsible party (manufacturer or importer). Declaration of Conformity (DoC) is an equipment authorization procedure that requires the responsible party to make measurements or take other necessary steps to ensure that the equipment complies with the appropriate technical standards. *See* 47 C.F.R. §§ 2.906, 2.909. Verification is an equipment authorization procedure under which the responsible party makes measurements or takes the necessary steps to ensure that the equipment complies with the appropriate technical standards. *See* 47 C.F.R. §§ 2.909(b), 2.953.

⁷⁰⁹ *See* 47 C.F.R. § 2.901 *et seq.*

⁷¹⁰ *See, e.g.*, 47 C.F.R. §§ 24.51, 27.51, which require that personal communications services (PCS) and WCS devices be authorized under the Certification procedure, respectively.

⁷¹¹ Currently, Part 25 defines earth station transceivers as portable if the transceivers' radiating element would be used within 20 centimeters of the operator's body while the devices are in use. *See* 47 C.F.R. § 25.129 (requiring Certification for portable earth station transceivers).

⁷¹² *See* 47 C.F.R. § 25.149(c).

⁷¹³ *See* 47 C.F.R. § 27.51, *citing* Part 2, Subpart J of the Commission's rules, 47 C.F.R. § 2.901 *et seq.*

⁷¹⁴ *2007 Notice*, 22 FCC Rcd at 22138 ¶ 43.

⁷¹⁵ Sirius Comments at 10.

or Declaration of Conformity – to authorize makes and models of terrestrial repeaters currently in operation.⁷¹⁶ The WCS Coalition, in its *ex parte* filings, did not oppose the 24-month window proposed by Sirius XM. The WCS Coalition also recommends imposing the same equipment authorization procedure on SDARS terrestrial repeaters that has been imposed on WCS transmitters. According to the WCS Coalition, Certification of SDARS terrestrial repeaters is necessary to ensure that the repeaters being deployed are compliant with the Commission's technical rules, especially given that XM and Sirius have a track record of deploying equipment that does not meet the Commission's technical rules.⁷¹⁷

303. *Discussion.* We agree with Sirius and the WCS Coalition that requiring Certification for SDARS terrestrial repeaters is in the public interest since it will create a parallel regulatory process for both SDARS and WCS transmitters, and will help ensure compliance with the technical standards that are necessary for co-existence of SDARS and WCS operations in the 2.3 GHz band. Accordingly, we require that SDARS terrestrial repeaters be authorized under the Certification procedure before they are imported or commercially distributed in the United States. In addition, to ensure that SDARS terrestrial repeaters comply with the power, PAPR, and OOB limits that we adopt in this Order, we require that the tests performed as part of the Certification procedure be completed in accordance with prescribed procedures.⁷¹⁸

304. As such, Sirius XM must request Certification for any terrestrial repeater models that it intends to deploy in the future, including models of repeaters that have been deployed previously in other locations under an STA. An SDARS licensee applying for blanket authority to operate terrestrial repeaters must certify, as part of its application, that each SDARS terrestrial repeater it plans to use has been authorized by the Commission under its Certification equipment authorization procedure. We recognize that it will take time to complete the Certification equipment authorization procedure for all terrestrial repeater models that are to be deployed under the initial blanket license application that is expected to be filed after adoption of this *Second Report and Order*. Accordingly, Sirius XM may request a waiver, as part of its initial blanket license application, of the requirement that it certify that all repeater models intended to be deployed have been authorized by the Commission under its Certification equipment authorization procedure. Instead, Sirius XM may request that any grant be conditioned on Sirius XM providing this Certification within 24 months of the grant of the authorization.⁷¹⁹ This would allow time sufficient time to establish and complete Certification procedures for the initial deployment of terrestrial repeaters under the rules adopted today. This waiver request may also seek to exempt from the initial blanket license application certification any models of terrestrial repeaters currently deployed, but that are no longer being manufactured and that will not have additional deployments in the future. We find that exempting such discontinued models from the Certification equipment authorization procedure will not undermine the purpose of the rule, since the exemption is likely to cover a limited number of already-deployed repeaters, and that it would be an undue hardship for Sirius XM to undergo the expense of Certification for models of repeaters that it does not intend to deploy in the future. Such repeaters,

⁷¹⁶ Sirius XM Comments at 38, filed April 23, 2010.

⁷¹⁷ WCS Coalition, July 22, 2008, *Ex Parte* at 2, n.3.

⁷¹⁸ The Commission's rules provide for "Commission-approved measurement techniques" in other contexts. See Sections 24.232(d), 27.50(b)(12), and 90.542(a)(8)(ii) of the Commission's rules, 47 C.F.R. §§ 24.232(d), 27.50(b)(12), 90.542(a)(8)(ii). See Section 25.144(e)(7) of the Commission's rules, in Appendix B to this Order for the terrestrial repeater equipment authorization requirements we are adopting. Specifically, Sections 25.144(e)(7)(i) and (iii) correspond to Sections 27.51(a) and (b), respectively. Section 25.144(e)(7)(ii) includes the new equipment authorization procedures we adopt here.

⁷¹⁹ Sirius XM requested this 24-month period to complete the equipment Certification procedures in comments in response to the *WCS/SDARS Technical Rules Public Notice*. See Sirius XM Comments at 38, filed April 23, 2010. No party opposed this request.

however, must still meet the power, PAPR, and OOB limits for SDARS terrestrial repeaters adopted in this *Second Report and Order*.

C. Other SDARS Repeater Issues

1. Local Programming Origination from SDARS Repeaters

305. *Background.* The Commission tentatively concluded that a prohibition on the use of terrestrial repeaters to originate local programming would serve the public interest as part of the *1997 Further Notice* and the *2007 Notice*.⁷²⁰ Terrestrial radio broadcasters support such a prohibition on transmission of local programming by SDARS repeaters, arguing that absent such a prohibition, SDARS licensees could compete with local radio for advertising, which in turn could limit local radio's ability to provide valuable public services.⁷²¹

306. *Discussion.* We affirm the Commission's tentative conclusion to impose a prohibition on the use of SDARS terrestrial repeaters to originate local programming and advertising. Since the release of the *2007 Notice*, the Commission has approved the merger of the two SDARS licensees, Sirius and XM.⁷²² As part of that merger proceeding, the Commission considered requests from terrestrial broadcasters to prohibit the merged companies from carrying local programming and local advertising in order to protect the ability of terrestrial broadcasters to provide free over-the-air radio.⁷²³ In response to the concerns expressed by the terrestrial broadcasters, Sirius and XM reiterated their commitment not to originate local programming or advertising through their repeater networks.⁷²⁴ In approving the merger request, the Commission observed that the existing STAs to operate terrestrial repeaters prohibit the licensees from using terrestrial repeaters to distribute localized content that is different from that provided via satellite to subscribers in the conterminous U.S., and thus prohibits SDARS licensees from distributing local programming as well as advertising.⁷²⁵

307. In order to effect the prohibition on the origination of local programming and advertising, we are adopting as a rule the following rule for all SDARS repeater operations: "SDARS terrestrial repeaters are restricted to the simultaneous retransmission of the complete programming, and only that programming, transmitted by the SDARS licensee's satellite directly to the SDARS licensee's subscribers' receivers, and may not be used to distribute any information not also transmitted to all subscribers' receivers." This language differs from the local programming restriction placed on SDARS repeater STAs in that it adds the phrase "and may not be used to distribute any information not also transmitted to all subscribers' receivers," which is not part of the repeater STA condition.⁷²⁶ The additional phrase results from an agreement reached by NAB and XM Radio subsequent to the creation of the SDARS repeater STA condition.⁷²⁷ Sirius XM states in recent comments that the additional phrase is

⁷²⁰ See *SDARS Order and FNPRM*, 12 FCC Rcd at 5812; *2007 Notice*, 22 FCC Rcd at 22142 ¶ 55.

⁷²¹ NAB Comments at 10-12.

⁷²² See *Sirius XM Merger Order*, 23 FCC Rcd at 12420 ¶ 155.

⁷²³ *Id.*

⁷²⁴ Sirius Comments at 38; XM Comments at 41-42.

⁷²⁵ See *SDARS Merger Order*, 23 FCC Rcd at 12420 ¶ 155.

⁷²⁶ The requirement we adopt today also slightly modifies the language of the condition placed on grants of STA to operate terrestrial repeaters, in that we make explicit that the programming retransmitted by terrestrial repeaters must be the same that is simultaneously transmitted to SDARS subscribers' receivers by a satellite licensed to a SDARS licensee, not just any satellite.

⁷²⁷ NAB Comments at 12-13.

unnecessary because it accomplishes the same objective as the STA condition: requiring Sirius XM offer only programming stream nationwide, which is available to all satellite receivers, in order to prevent Sirius XM from using terrestrial repeaters to originate local content to compete with terrestrial radio broadcasters on a local basis.⁷²⁸

308. Sirius XM does not, however, identify any concrete harm from inclusion of this language. It states that this additional phrase could cause confusion and harm if it were interpreted to restrict non-programming related activities unrelated to the concerns of terrestrial broadcasters, such as the origination and transmission of diagnostic data.⁷²⁹ In order to address this concern, we make clear that prohibition applies only to subscriber-received programming and does not restrict Sirius XM from originating internal diagnostic or network maintenance transmissions from terrestrial repeaters. Finally, XM asks us to clarify that this language does not prohibit the slight delay caused by retransmission of the satellite signal through a terrestrial repeater.⁷³⁰ We confirm that slight transmission delays inherent from RF propagation delays, signal processing, and the use of time diversity techniques do not violate the prohibition on the use of SDARS repeaters to originate local programming and advertising, so long as all programming and advertising transmitted by the licensee's SDARS repeaters is the same and complete programming and advertising that is received from, and transmitted by, the licensee's satellite to all end users. Such technical delays do not violate our intent that the use of SDARS repeaters remains complementary to a satellite service, and interpreting the prohibition not to cover such technical delays is supported both by the SDARS operators and by NAB.⁷³¹

2. Use of SDARS Spectrum for Repeaters

309. *Background.* In the *1997 Further Notice*, the Commission proposed allowing SDARS licensees to use their licensed spectrum for both satellite and terrestrial repeater transmissions.⁷³² A terrestrial broadcast radio licensee, Mt. Wilson FM Broadcasters, claimed that the Table of Frequency Allocations permits SDARS spectrum to be used only for satellite transmissions, and that use of satellite spectrum for terrestrial repeater transmissions would be inconsistent with the Table of Frequency Allocations.⁷³³ In the *2007 Notice*, the Commission invited interested parties to update the record on this issue.⁷³⁴ No one commented on this issue.

310. *Discussion.* We disagree that SDARS operators should be required to operate their repeaters in a frequency band different from that in which they operate their satellites. First, such a requirement would be inconsistent with the international and domestic spectrum allocations for SDARS.

⁷²⁸ Sirius XM Comments at 41, filed April 23, 2010.

⁷²⁹ *Id.*

⁷³⁰ XM Comments at 42 n.95.

⁷³¹ See XM Radio 2001 Public Notice Reply Comments at 22; NAB 2001 Public Notice Comments at 5.

⁷³² See *SDARS Order and FNPRM*, 12 FCC Rcd at 5845 (App. C), cited in *2007 Notice*, 22 FCC Rcd at 22140-41 ¶ 52.

⁷³³ Mt. Wilson Further Notice Comments at 2, cited in *2007 Second Further Notice*, 22 FCC Rcd at 22141 ¶ 53. See also Susquehanna Further Notice Comments at 5, cited in *2007 Notice*, 22 FCC Rcd at 22141 ¶ 53 (arguing that diverting spectrum from SDARS satellite transmissions to terrestrial repeater transmissions would be inconsistent with finding in the *1997 SDARS Service Rules Order*, 12 FCC Rcd at 5776 ¶ 49, that the SDARS licensees will need 12.5 megahertz of spectrum to be economically viable).

⁷³⁴ *2007 Notice*, 22 FCC Rcd at 22141 ¶ 53.

Those allocations expressly state that SDARS spectrum is allocated “to the broadcasting-satellite service (sound) and a complementary terrestrial broadcasting service” on a primary basis (emphasis added).⁷³⁵

311. In addition, as the Commission stated in the *1997 SDARS Order*, satellite system design requires a balancing of various factors that is best made by the system operators.⁷³⁶ In order to allow SDARS licensees maximum flexibility to implement their satellite system designs, the Commission adopted flexible technical rules for the service, which in turn has allowed the licensees to implement robust systems that are both viable and competitive.⁷³⁷ Pursuant to this policy of permitting licensees flexibility in designing their systems, licensees should have the ability to decide whether to use a portion of their exclusively assigned spectrum to implement SDARS repeaters. In other words, the use of spectrum within a particular system represents a decision best made by the licensee to maximize the number of programming channels available and to provide a reliable, ubiquitous, and high quality programming service to consumers represents a decision best made by the licensee.⁷³⁸

3. Retransmission of Regional Spot Beams

312. *Background.* In response to the *1997 Further Notice*, one commenter urged the Commission to prohibit SDARS repeaters from re-transmitting satellite spot beams, arguing that providing localized programming via spot beams would in effect transform SDARS repeater networks into terrestrial radio services and undermine the viability of terrestrial broadcasters.⁷³⁹ Similarly, NAB has urged the Commission to prohibit SDARS licensees from delivering different programming to consumers in different markets.⁷⁴⁰ The *2007 Notice* invited commenters to update the record on this issue, observing that no SDARS licensee has constructed, or has proposed to construct, regional spot beams as part of its system.⁷⁴¹

313. *Discussion.* No comments were received on this issue in response to the *2007 Notice*. We conclude that SDARS operators should not use their SDARS repeaters to retransmit regional spot beams. Permitting SDARS licensees the ability to use their repeater networks to provide terrestrial radio programming that varies by region, including via the incorporation of spot beam technology in its satellite networks, would be in direct contradiction to the Commission’s intent for the use of terrestrial repeaters. Restricting the SDARS repeater’s operations to transmitting only the programming transmitted from the SDARS satellite directly to subscribers will more appropriately ensure that the Commission’s stated policy goals regarding a repeater’s ability to originate local programming, as discussed above in Section IV.C.1., are met.

⁷³⁵ 47 C.F.R. § 2.106 Footnote US 327 to U.S. Table of Frequency Allocations; International Telecommunication Union, Radio Regulations, Article S5.393 to the International Table of Frequency Allocations.

⁷³⁶ See *SDARS Order and FNPRM*, 12 FCC Rcd at 5800 ¶ 112.

⁷³⁷ *Id.*

⁷³⁸ Although SDARS licensees have the flexibility to determine whether to utilize their spectrum for use by complementary terrestrial repeaters and to determine how much of their licensed spectrum to set aside for such use, the rules we adopt in this *Second Report and Order* to minimize out-of-band emissions are premised on the location of repeater frequency assignments in the center of each SDARS licensee’s exclusively licensed frequency band.

⁷³⁹ Mt. Wilson Further Notice Comments at 1, 5, cited in *2007 Notice*, 22 FCC Rcd at 22141 ¶ 54.

⁷⁴⁰ Letter from Jack N. Goodman, Senior Vice President and General Counsel, NAB, to William F. Caton, Acting Secretary, FCC (dated Mar. 14, 2002), cited in *2007 Notice*, 22 FCC Rcd at 22141 ¶ 54.

⁷⁴¹ *2007 Notice*, 22 FCC Rcd at 22141 ¶ 54.

D. Petitions for Reconsideration

314. We deny the petitions for reconsideration of the 1997 *SDARS Order*⁷⁴² filed by the Consumer Electronics Manufacturing Association (CEMA)⁷⁴³ and the Cellular Phone Taskforce.⁷⁴⁴ CEMA filed a petition for reconsideration of the 1997 *SDARS Order* urging the Commission to adopt rules governing the build-out of SDARS repeaters and regulating the overall performance of SDARS systems, particularly in urban and mobile environments.⁷⁴⁵ CEMA expresses concern that SDARS licensees will resist bearing the costs associated with deployment of SDARS repeaters without the imposition of specific repeater build-out requirements.⁷⁴⁶ We conclude that there is no need for additional build-out, coverage, quality, or performance requirements for SDARS repeaters. We conclude that competitive market forces will provide ample incentives for the SDARS licensees to deliver high quality, nationwide service in a timely manner. This conclusion is supported by the fact that, since the filing of CEMA's petition for reconsideration, the SDARS licensees have in fact extensively built out their repeater networks without the imposition of a build out requirement. Consequently, we deny CEMA's petition and will not impose any mandatory build out requirements for the deployment of SDARS repeaters.

315. The Cellular Phone Taskforce opposes licensing SDARS repeaters because of their alleged environmental effects.⁷⁴⁷ In its comments, the Cellular Phone Taskforce does not raise specific environmental concerns regarding our proposed rules for SDARS. Rather, it argues that the Commission's environmental rules are generally inadequate. Because the Cellular Phone Taskforce did not raise any specific concerns regarding SDARS repeater operations, we find that it is unnecessary and inappropriate to impose additional environmental restrictions on the operations of SDARS repeaters based on its petition. We also conclude that it is not appropriate to address its general concerns about the sufficiency of the Commission's environmental rules in this particular licensing proceeding.

V. PROCEDURAL MATTERS

316. *Final Regulatory Flexibility Analysis.* As required by the Regulatory Flexibility Act (RFA),⁷⁴⁸ Initial Regulatory Flexibility Analyses (IRFA) for WT Docket No. 07-293 and IB Docket No. 95-91 were incorporated into the *2007 Notice*.⁷⁴⁹ The Commission sought written public comments on the possible significant economic impact of the proposed policies and rules on small entities in the *2007 Notice*, including comments on the IRFAs. No one commented specifically on the IRFAs. Pursuant to the RFA,⁷⁵⁰ Final Regulatory Flexibility Analyses are contained in Appendices C and D.

⁷⁴² Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band, *Report and Order, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking*, 12 FCC Rcd 5754 (1997) ("*SDARS Order and FNPRM*").

⁷⁴³ Petition for Reconsideration of the Consumer Electronics Manufacturing Association, IB Docket No. 95-91 (Mar. 27, 1997) ("*CEMA Reconsideration Petition*").

⁷⁴⁴ Petition for Partial Reconsideration of the Cellular Phone Taskforce, IB Docket No. 95-91 (Apr. 9, 1997) ("*Cellular Phone Taskforce Reconsideration Petition*").

⁷⁴⁵ *See id.* at 7-8.

⁷⁴⁶ *See* CEMA Reconsideration Petition at 2.

⁷⁴⁷ *See* Cellular Phone Taskforce Reconsideration Petition at 1.

⁷⁴⁸ *See* 5 U.S.C. § 603.

⁷⁴⁹ *2007 Notice*, 12 FCC Rcd at 22146-50 (Appendix A and Appendix B).

⁷⁵⁰ *See* 5 U.S.C. § 604.

317. *Paperwork Reduction Act.* This Order contains new and modified information collections subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. It will be submitted to the Office of Management and Budget (OMB) for review under Section 3507(d) of the PRA. The Commission will publish a separate notice in the Federal Register inviting comment on the new or revised information collection requirements adopted herein. The requirements will not go into effect until OMB has approved it and the FCC has published a notice announcing the effective date of the information collection requirements. In addition, we note that pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, see 44 U.S.C. 3506(c)(4), we previously sought specific comment on how the Commission might “further reduce the information collection burden for small business concerns with fewer than 25 employees.” In this present document, we have assessed the potential effects of the various policy changes with regard to information collection burdens on small business concerns, and find that these requirements will benefit WCS licensees with fewer than 25 employees. In addition, we have described impacts that might affect small businesses, including most businesses with fewer than 25 employees, in the Final Regulatory Flexibility Analysis in Appendix C, *infra*.

VI. ORDERING CLAUSES

318. Accordingly, IT IS ORDERED, pursuant to Sections 4(i), 7(a), 303(c), 303(f), 303(g), and 303(r), and 307 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 157(a), 303(c), 303(f), 303(g), 303(r), 307, that this *Report and Order* in WT Docket No. 07-293 and *Second Report and Order* in IB Docket No. 95-91 is hereby ADOPTED.

319. IT IS FURTHER ORDERED that the rules adopted herein WILL BECOME EFFECTIVE 30 days after the date of publication in the Federal Register, except for Sections 25.144(e)(3), 25.144(e)(8), 25.144(e)(9), 25.263(b), 25.263(c), 27.14(p)(7), 27.72(b), 27.72(c), 27.73(a), and 27.73(b), which contain new or modified information collection requirements that require approval by the OMB under the PRA and WILL BECOME EFFECTIVE after the Commission publishes a notice in the Federal Register announcing such approval and the relevant effective date.

320. IT IS FURTHER ORDERED THAT, pursuant to Sections 4(i) and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 303(r), and Section 1.115 of the Commission's Rules, 47 C.F.R. § 1.115, the application for review of the Wireless Telecommunications Bureau's Horizon Order,⁷⁵¹ jointly filed by Green Flag Wireless, LLC and James McCotter on February 10, 2009, IS DISMISSED AS MOOT.

321. IT IS FURTHER ORDERED THAT, pursuant to Sections 4(i) and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 303(r), the applications for additional time to meet the 2.3 GHz Wireless Communications Service substantial service performance requirement listed in Appendix F ARE DISMISSED AS MOOT.

322. IT IS FURTHER ORDERED THAT, pursuant to Section 5(c) of the Communications Act of 1934, as amended, 47 U.S.C. § 5(c), the Wireless Telecommunications Bureau IS GRANTED DELEGATED AUTHORITY to implement the policies set forth in the Report and Order in WT Docket No. 07-293 and the rules, as revised, set forth in Appendix B hereto.

323. IT IS FURTHER ORDERED, that the International Bureau is instructed to extend all grants of STA to operate SDARS repeaters currently in effect for a period of 180 days from the effective

⁷⁵¹ Applications of Horizon Wi-Com, LLC, File Nos. 0003014435, 0003014449, 0003014463, 0003014470, 0003045272, 0003045277, 0003045282, and 0003067727, *Memorandum Opinion and Order*, 24 FCC Rcd 359 (WTB Mobility Div. 2009) (*Horizon Order*).

date of this Order, or until the date on which the Commission grants blanket licenses to operate SDARS repeaters, whichever comes first.

324. IT IS FURTHER ORDERED, that the International Bureau is instructed to grant all pending requests for STA to operate SDARS terrestrial repeaters for a period of 180 days from the effective date of this Order, or until the date on which the Commission grants blanket licenses to operate SDARS repeaters, whichever comes first.

325. IT IS FURTHER ORDERED that the petition for reconsideration filed in 12 FCC Rcd 5754, IB Docket No. 95-91, GEN Docket No. 90-357, on March 27, 1997 by the Consumer Electronics Manufacturers Association, and the petition for partial reconsideration filed in 12 FCC Rcd 5754, IB Docket No. 95-91, GEN Docket No. 90-357, on April 9, 1997 by the Cellular Phone Taskforce ARE DENIED.

326. IT IS FURTHER ORDERED that the Commission will send a copy of this Report and Order and Second Report and Order, including the Final Regulatory Flexibility Analysis and Final Regulatory Flexibility Certification, in a report to be sent to Congress and the Government Accountability Office pursuant to the Congressional Review Act, *see* 5 U.S.C. 801(a)(1)(A).

327. IT IS FURTHER ORDERED, pursuant to Sections 4(i) and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 303(r), and Sections 1.9030(c) and 1.9035(c) of the Commission's rules, 47 C.F.R. §§ 1.9030(c), 1.9035(c), that all licensees and de facto transfer lessees of spectrum in the 2305-2320 MHz and 2345-2360 MHz bands are HEREBY DIRECTED to provide Sirius XM Radio, Inc. an inventory of their deployed infrastructure consistent with, and within 30 days of the effective date of, new Section 27.72(b).

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A

List of Parties Filing Pleadings

I. Pleadings Filed in IB Docket No. 95-91 in Response to the 1997 Further Notice**A. Comments (filed on or before June 13, 1997)**

Alabama Broadcasters Association
American Mobile Radio Corporation (AMRC)
CD Radio, Inc. (CD Radio)
Consumer Electronics Manufacturers Association (CEMA)
Mt. Wilson FM Broadcasters, Inc.
National Association of Broadcasters (NAB)
Susquehanna Radio Corp.

B. Reply Comments (filed on June 27, 1997)

AMRC
CD Radio
CEMA
NAB
Radio Operators Caucus

C. Ex Parte Filings (June 28, 1997 through December 17, 1999)

AMRC
CD Radio
CEMA
Mt. Wilson FM Broadcasters, Inc
NAB
XM

II. Supplemental Pleadings Filed in IB Docket No. 95-91 ¹**A. Supplements to 1997 Filings**

Supplemental Comments of XM, filed Dec. 17, 1999 (XM 1999 Supplement)
Supplemental Comments of Sirius, filed Jan. 18, 2000 (Sirius 2000 Supplement)

B. Comments (filed on February 22, 2000)

BellSouth Corporation and BellSouth Wireless Cable, Inc. (BellSouth)
NAB
Wireless Communications Association International, Inc. (WCA)

¹ "Satellite Policy Branch Information," *Public Notice*, IB Docket No. 95-91, GEN Docket No. 90-357, rel. Jan. 21, 2000.

C. Reply Comments (filed on March 8, 2000)

Aerospace & Flight Test Radio Coordinating Council (AFTRCC)
 MCI WorldCom, Inc.
 Metricom, Inc. (Metricom)
 Sirius
 XM

D. Ex Parte Filings (from March 8, 2000 through December 13, 2001)

AFTRCC, Sirius, and XM
 ATT&T Wireless Services, Inc. (ATTWS)
 ATTWS, BeamReach Networks, Inc. (BeamReach), BellSouth, Metricom, WCA, and WorldCom
 ATTWS, BeamReach, BellSouth, Metricom, Navini Networks Inc. (Navini Networks), Sirius, Verizon
 Wireless, Inc. (Verizon Wireless), WCA, WorldCom, and XM
 ATTWS, BellSouth, Metricom, Verizon Wireless, WCA, and WorldCom, Inc. (WorldCom)
 ATTWS, BellSouth, Metricom, and WCA
 ATTWS, BellSouth, Metricom, WCA, and WorldCom
 ATTWS and Verizon Wireless
 BeamReach
 BellSouth, Metricom, Shell Offshore Service Company, Sirius, WCA, WorldCom, and XM
 Fusion Lighting (Fusion)
 Metricom
 NAB
 Navini Networks
 Sirius
 Sirius and XM
 Spike Broadband Systems Inc.
 Verizon Wireless
 WCA
 XM

III. 2001 Public Notice Pleadings Filed in IB Docket No. 95-91 (DA 01-2570)²**A. Comments (filed on or before December 14, 2001)**

ATTWS, BeamReach, BellSouth Corporation, Metricom, Verizon Wireless, WorldCom, and WCA
 (WCS Coalition)
 KJNP AM/FM
 NAB
 National ITFS Association
 Sirius
 S-R Broadcasting Co., Inc.
 WCA
 XM

² “Request for Further Comment on Selected Issues Regarding the Authorization of Satellite Digital Audio Radio Service Terrestrial Repeater Networks,” *Public Notice*, IB Docket No. 95-91, RM-8610, DA 01-2570, 16 FCC Red 19435 (2001).

B. Reply Comments (due on or before December 21, 2001)

BeamReach
NAB
NIA
Sirius
WCA
WCS Coalition
XM

IV. Pleadings Filed between Dec. 22, 2001 and Feb. 12, 2008**A. *Ex Parte* Filings**

ATTWS
BeamReach
BellSouth
Cox Radio, Inc. (Cox)
Fusion
Green Flag Wireless, LLC
NAB
NAB and XM
NextWave Broadband Inc. (NextWave)
XM

B. Selected Pleadings

White Paper: Interference to the SDARS Service from WCS Transmitters, attached to Letter from Carl R. Frank, Counsel to Sirius Satellite Radio Inc., to Marlene H. Dortch, Secretary, FCC (dated Mar. 29, 2006) (Sirius 2006 White Paper)
Sirius Satellite Radio Inc. Petition for Rulemaking and Comments, filed Oct. 17, 2006 (Sirius Petition for Rulemaking)
Letter from Paul J. Sinderbrand, Counsel to the WCS Coalition, to Marlene H. Dortch, Secretary, FCC (dated July 9, 2007) (WCS July 2007 Letter)

V. Pleadings Filed in Response to 2007 Notice**A. Comments in IB Docket No. 95-91 (due on or before February 14, 2008)**

AFTRCC
Alaska Broadcasters Association and Hawaii Association of Broadcasters (Alaska/Hawaii Broadcasters)
Motorola, Inc. (Motorola)
NAB
Sirius
AT&T, Inc., Comcast Corporation (Comcast), Horizon Wi-Com LLC (Horizon), NTELOS Inc. and NextWave Broadband Inc., WCA (WCS Coalition)
WiMAX Forum
XM Radio, Inc. (XM)
XM Supplement, filed Feb. 15, 2008
XM and Sirius Letter, filed Feb. 28, 2009

B. Comments in WT Docket No. 07-293 (due on or before February 14, 2008)

George Bednekoff (Bednekoff)

C. Reply Comments in IB Docket No. 95-91 (due on or before March 17, 2008)

NextWave Wireless, Inc. (NextWave)
Sirius
WCS Coalition
WiMAX Forum
XM

VI. Comments Filed in WT Docket No. 07-293 in Response to WCS Performance Requirements Public Notice (FCC 10-46)**A. Comments (due on April 21, 2010)**

Broadband South LLC (Broadband South)
Green Flag Wireless, LLC, CWC License Holding, Inc. and James McCotter, Joint Comments of
Horizon
Sirius XM
Stratos Offshore Services Company (Stratos)
WCS Coalition

B. Reply Comments for WCS Performance Requirements Public Notice (due on or before May 3, 2010)

AT&T Inc
Broadband South
Comcast
Green Flag Wireless, LLC, CWC License Holding, Inc., James McCotter
Horizon
Sirius XM
WCS Coalition

C. Late-filed Comments

Grid Net (Apr. 29)

VII. Filings in Response to Interference Rules Public Notice (DA 10-592 and DA 10-622)³**A. Comments Filed in WT Docket No. 07-293 (due on or before April 23, 2010)**

AFTRCC
Alliance of Automobile Manufacturers (filed under Robert Strassburger)
Association of International Automobile Manufacturers, Inc. (AIAM), Technical Affairs Committee of
Boeing Company, The (Boeing)
Ericsson Inc
GE Healthcare

³ The Commission extended the comment date to April 23, 2010. "Commission Staff Requests That Interested Parties Supplement the Record on Draft Interference Rules for Wireless Communications Service and Satellite Digital Audio Radio Service," WT Docket No. 07-293, *Order Extending Comment Period*.

Hyundai Motor America
Mercedes-Benz USA, LLC
National Automobile Dealers Association (NADA)
Nissan North America, Inc.
Philips Healthcare Systems
Satellite Industry Association
Sirius XM
Stratos
Telecommunications Industry Association (TIA)
Vogel, Wolfhard (Balcones Industrial R&D Corporation)
WCS Coalition

In addition, 353 short comments were filed in WT Docket No. 07-293 between March 6, 2010 and April 26, 2010, from parties generally requesting that the Commission protect the reception of Sirius XM's programming.

B. Late-filed Comments

AFTRCC ("Reply Comments" filed on Apr. 30)
AIAM (Apr. 29)
American Trucking Associations (Apr. 26)
Chrysler (May 3)
Ford Motor Company (May 3)
Sirius XM ("Supplemental Comments" filed on Apr. 29; "Comments" filed on May 13)

VIII. 2010 *Ex Parte* Filings

AFTRCC
AFTRCC, Boeing, Raytheon Company, Textron Corporation, Lockheed Martin Corporation, and Dr. Jablonski
AFTRCC, Boeing, Raytheon Company, Textron Corporation, and Dr. Jablonski
Alcatel-Lucent
Alliance of Automobile Manufacturers
Anthony Weiner, Gary Ackerman, Joseph Crowley, Steve Israel, and Louise Slaughter – Members of Congress
Boeing
Chrysler
Columbia Capital
Ford Motor Company
Fred Upton and Mike Rogers – Members of Congress
General Motors North American Operations
Horizon
Horizon, Kolodzy Consulting Inc., NextWave, NRTC, and WCS Coalition
Horizon and NextWave
Horizon, NextWave, National Rural Telecommunications Cooperative, and WCS Coalition
Hyundai Motor America
Kia Motors America, Inc.
Land Rover North America Inc.
NextWave
Olympia Snowe, United States Senator
Sirius XM
Sprint Nextel
Stratos

TIA
Toyota Motor Sales, USA, Inc.
Volvo Cars of North America, LLC
WCS Coalition

APPENDIX B

Rule Revisions

For the reasons discussed above, the Federal Communications Commission amends Title 47 of the Code of Federal Regulations, Part 2, as follows:

Part 2 – Table of Frequency Allocations

1. The authority citation for Part 2 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, and 336, unless otherwise noted.

2. Amend Section 2.106 US338 to read as follows:

US338 The following provisions shall apply in the band 2305-2320 MHz:

- (a) In the sub-band 2305-2310 MHz, space-to-Earth operations are prohibited.
- (b) Within 145 km of Goldstone, CA (35° 25' 33" N, 116° 53' 23" W), Wireless Communications Service (WCS) licensees operating base stations in the band 2305-2320 MHz shall, prior to operation of those base stations, achieve a mutually satisfactory coordination agreement with the National Aeronautics and Space Administration (NASA).

NOTE: NASA operates a deep space facility in Goldstone in the band 2290-2300 MHz.

For the reasons discussed above, the Federal Communications Commission amends Title 47 of the Code of Federal Regulations, Part 25, as follows:

PART 25 – SATELLITE COMMUNICATIONS

1. The authority citation for Part 25 continues to read as follows:

Authority: 47 U.S.C. 701-744. Interprets or applies Sections 4, 301, 302, 303, 307, 309, and 332 of the Communications Act, as amended, 47 U.S.C. Sections 154, 301, 302a, 303, 307, 309, and 332, unless otherwise noted.

2. Amend Section 25.121 by revising paragraph (a) to read as follows:

§ 25.121 License term and renewals.

(a) License Term. (1) Except for licenses for DBS space stations, SDARS space stations and terrestrial repeaters, and 17/24 GHz BSS space stations licensed as broadcast facilities, licenses for facilities governed by this part will be issued for a period of 15 years.

(2) Licenses for DBS space stations and 17/24 GHz BSS space stations licensed as broadcast facilities, and for SDARS space stations and terrestrial repeaters, will be issued for a period of 8 years. Licenses for DBS space stations not licensed as broadcast facilities will be issued for a period of 10 years.

* * * * *

3. Amend Section 25.144 by revising paragraph (d) and adding paragraph (e), to read as follows:

§ 25.144 Licensing provisions for the 2.3 GHz satellite digital audio radio service.

* * * * *

(d) The license term for each digital audio radio service satellite and any associated terrestrial repeaters are specified in § 25.121 of this chapter.

(e) SDARS Terrestrial Repeaters.

(1) Only entities holding or controlling SDARS space station licenses may construct and operate SDARS terrestrial repeaters and such construction and operation is permitted only in conjunction with at least one SDARS space station that is concurrently authorized and transmitting directly to subscribers.

(2) SDARS terrestrial repeaters will be eligible for blanket licensing only under the following circumstances:

(i) The SDARS terrestrial repeaters will comply with all applicable power limits set forth in § 25.214(d)(1) of this chapter and all applicable out-of-band emission limits set forth in § 25.202(h)(1) and (2) of this chapter.

(ii) The SDARS terrestrial repeaters will meet all applicable requirements in part 1, subpart I, and part 17 of this chapter. Operators of SDARS terrestrial repeaters must maintain demonstrations of compliance with part 1, subpart I, of this chapter and make such demonstrations available to the Commission upon request within three business days.

(iii) The SDARS terrestrial repeaters will comply with all requirements of all applicable international agreements.

(3) After **[Insert release date of Order]**, SDARS licensees shall, before deploying any new, or modifying any existing, terrestrial repeater, notify potentially affected WCS licensees pursuant to the procedure set forth in § 25.263 of this chapter.

(4) SDARS terrestrial repeaters are restricted to the simultaneous retransmission of the complete programming, and only that programming, transmitted by the SDARS licensee's satellite(s) directly to the SDARS licensee's subscribers' receivers, and may not be used to distribute any information not also transmitted to all subscribers' receivers.

(5) Operators of SDARS terrestrial repeaters are prohibited from using those repeaters to retransmit different transmissions from a satellite to different regions within that satellite's coverage area.

(6) Operators of SDARS terrestrial repeaters are required to comply with all applicable provisions of part 1, subpart I, and part 17 of this chapter.

(7)(i) Each SDARS terrestrial repeater transmitter utilized for operation under this paragraph must be of a type that has been authorized by the Commission under its certification procedure.

(ii) In addition to the procedures set forth in subpart J of part 2 of this chapter, power measurements for SDARS repeater transmitters may be made in accordance with a Commission-approved average power technique. Peak-to-average power ratio (PAPR) measurements for SDARS repeater transmitters should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that the PAPR will not exceed 13 dB for more than 0.1 percent of the time or another Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

(iii) Any manufacturer of radio transmitting equipment to be used in these services may request equipment authorization following the procedures set forth in subpart J of part 2 of this chapter. Equipment authorization for an individual transmitter may be requested by an applicant for a

station authorization by following the procedures set forth in part 2 of this chapter.

(8) Applications for blanket authority to operate terrestrial repeaters must be filed using Form 312, except that Schedule B to Form 312 need not be filed. Such applications must also include the following information as an attachment:

(i) The space station(s) with which the terrestrial repeaters will communicate, the frequencies and emission designators of such communications, and the frequencies and emission designators used by the repeaters to re-transmit the received signals.

(ii) The maximum number of terrestrial repeaters that will be deployed under the authorization at 1) power levels equal to or less than 2-watt average EIRP, and 2) power levels greater than 2-watt average EIRP (up to 12-kW average EIRP).

(iii) A certification of compliance with the requirements of § 25.144(e)(1) through (7) of this chapter.

(9) SDARS terrestrial repeaters that are ineligible for blanket licensing must be authorized on a site-by-site basis. Applications for site-by-site authorization must be filed using Form 312, except that Schedule B need not be provided. Such applications must also include the following information, as an attachment:

(i) The technical information for each repeater required to be shared with potentially affected WCS licensees as part of the notification requirement set forth in § 25.263(c)(2) of this chapter.

(ii) The space station(s) with which the terrestrial repeaters will communicate, the frequencies and emission designators of such communications, and the frequencies and emission designators used by the repeaters to re-transmit the received signals.

4. Amend Section 25.202 by adding paragraph (a)(10), revising the introductory language of paragraph (f), and adding paragraph (h), to read as follows:

§ 25.202 Frequencies, frequency tolerance, and emission limitations.

(a) * * *

(10) The following frequencies are available for use by the Satellite Digital Audio Radio Service (SDARS), and for any associated terrestrial repeaters:

2320-2345 MHz (space-to-Earth)

* * * * *

(f) Emission limitations. Except for SDARS terrestrial repeaters, the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the schedule set forth in paragraphs (f)(1) through (f)(4) of this section. The out-of-band emissions of SDARS terrestrial repeaters shall be attenuated in accordance with the schedule set forth in paragraph (h) of this section.

* * * * *

(h) Out-of-band emission limitations for SDARS terrestrial repeaters.

(1) Any SDARS terrestrial repeater operating at a power level greater than 2-watt average EIRP is required to attenuate its out-of-band emissions below the transmitter power P by a factor of not less than $90 + 10 \log (P)$ dB in a 1-megahertz bandwidth outside the 2320-2345 MHz band, where P is average transmitter output power in watts.

(2) Any SDARS terrestrial repeater operating at a power level equal to or less than 2-watt average EIRP is required to attenuate its out-of-band emissions below the transmitter power P by a factor of not less than $75 + 10 \log (P)$ dB in a 1-megahertz bandwidth outside the 2320-2345 MHz band, where P is average transmitter output power in watts.

(3) SDARS repeaters are permitted to attenuate out-of-band emissions less than the levels specified in paragraphs (1) and (2) above, unless a potentially affected WCS licensee provides written notice that it intends to commence commercial service within the following 365 days. Starting 180 days after receipt of such written notice, SDARS repeaters within the area notified by the potentially affected WCS licensee must attenuate out-of-band emissions to the levels specified in paragraphs (1) and (2) above.

(4) For the purpose of this section, a WCS licensee is potentially affected if it meets any of the following criteria:

(i) The WCS licensee is authorized to operate a base station in the 2305-2315 MHz or 2350-2360 MHz bands in the same Major Economic Area (MEA) as that in which a SDARS terrestrial repeater is located.

(ii) The WCS licensee is authorized to operate a base station in the 2315-2320 MHz or 2345-2350 MHz bands in the same Regional Economic Area Grouping (REAG) as that in which a SDARS terrestrial repeater is located.

(iii) A SDARS terrestrial repeater is located within 5 kilometers of the boundary of an MEA or REAG in which the WCS licensee is authorized to operate a WCS base station.

5. Amend Section 25.214 by revising the title and adding paragraph (d) to read as follows:

§ 25.214 Technical requirements for space stations in the satellite digital audio radio service and associated terrestrial repeaters.

* * * * *

(d) Power limit for SDARS terrestrial repeaters.

(1) SDARS terrestrial repeaters must be operated at a power level less than or equal to 12-kW average EIRP, with a maximum peak-to-average power ratio of 13 dB.

(2) SDARS repeaters are permitted to operate at power levels above 12-kW average EIRP, unless a potentially affected WCS licensee provides written notice that it intends to commence commercial service within the following 365 days. Starting 180 days after receipt of such written notice, SDARS repeaters within the area notified by the potentially affected WCS licensee must be operated at a power level less than or equal to 12-kW average EIRP, with a maximum peak-to-average power ratio of 13 dB.

(3) For the purpose of this section, a WCS licensee is potentially affected if it meets any of the following criteria:

(i) The WCS licensee is authorized to operate a base station in the 2305-2315 MHz or 2350-2360 MHz bands in the same Major Economic Area (MEA) as that in which a SDARS terrestrial

repeater is located.

(ii) The WCS licensee is authorized to operate a base station in the 2315-2320 MHz or 2345-2350 MHz bands in the same Regional Economic Area Grouping (REAG) as that in which a SDARS terrestrial repeater is located.

(iii) A SDARS terrestrial repeater is located within 5 kilometers of the boundary of an MEA or REAG in which the WCS licensee is authorized to operate a WCS base station.

6. Add Section 25.263 to read as follows:

§ 25.263 Information sharing requirements for SDARS terrestrial repeater operators.

This section requires SDARS licensees in the 2320-2345 MHz band to share information regarding the location and operation of terrestrial repeaters with WCS licensees in the 2305-2320 MHz and 2345-2360 MHz bands. Section 27.72 of this chapter requires WCS licensees to share information regarding the location and operation of base stations in the 2305-2320 MHz and 2345-2360 MHz bands with SDARS licensees in the 2320-2345 MHz band.

(a) SDARS licensees must select terrestrial repeater sites and frequencies, to the extent practicable, to minimize the possibility of harmful interference to WCS base station operations in the 2305-2320 MHz and 2345-2360 MHz bands.

(b) Notice Requirements. SDARS licensees that intend to operate a new terrestrial repeater must, before commencing such operation, provide 10 business days prior notice to all potentially affected WCS licensees. SDARS licensees that intend to modify an existing repeater must, before commencing such modified operation, provide 5 business days prior notice to all potentially affected WCS licensees.

(1) For purposes of this section, a "potentially affected WCS licensee" is a WCS licensee that: (i) is authorized to operate a base station in the 2305-2315 MHz or 2350-2360 MHz bands in the same Major Economic Area (MEA) as that in which the terrestrial repeater is to be located; (ii) is authorized to operate a base station in the 2315-2320 MHz or 2345-2350 MHz bands in the same Regional Economic Area Grouping (REAG) as that in which the terrestrial repeater is to be located. (iii) In addition to the WCS licensees identified in paragraphs (b)(1)(i) and (ii) of this section, in cases in which the SDARS licensee plans to deploy or modify a terrestrial repeater within 5 kilometers of the boundary of an MEA or REAG in which the terrestrial repeater is to be located, a potentially affected WCS licensee is one that is authorized to operate a WCS base station in that neighboring MEA or REAG within 5 kilometers of the location of the terrestrial repeater.

(2) For the purposes of this section, a business day is defined by § 1.4(e)(2) of this chapter.

(c) Contents of Notice.

(1) Notification must be written (*e.g.*, certified letter, fax, or email) and include the licensee's name, and the name, address, and telephone number of its coordination representative, unless the SDARS licensee and all potentially affected WCS licensees reach a mutual agreement to provide notification by some other means. WCS licensees and SDARS licensees may establish such a mutually agreeable alternative notification mechanism without prior Commission approval, provided that they comply with all other requirements of this section.

(2) Regardless of the notification method, notification must specify relevant technical details, including, at a minimum: (i) the coordinates of the proposed repeater to an accuracy of no less than ± 1 second latitude and longitude; (ii) the proposed operating power(s), frequency band(s), and emission(s);

(iii) the antenna center height above ground and ground elevation above mean sea level, both to an accuracy of no less than ± 1 meter; (iv) the antenna gain pattern(s) in the azimuth and elevation planes that include the peak of the main beam; and (v) the antenna downtilt angle(s).

(3) An SDARS licensee operating terrestrial repeaters must maintain an accurate and up-to-date inventory of its terrestrial repeaters operating above 2 watts average EIRP, including the information set forth in § 25.263(c)(2) of this chapter, which shall be available upon request by the Commission.

(d) Calculation of Notice Period. Notice periods are calculated from the date of receipt by the licensee being notified. If notification is by mail, the date of receipt is evidenced by the return receipt on certified mail. If notification is by fax, the date of receipt is evidenced by the notifying party's fax transmission confirmation log. If notification is by email, the date of receipt is evidenced by a return e-mail receipt. If the SDARS licensee and all potentially affected WCS licensees reach a mutual agreement to provide notification by some other means, that agreement must specify the method for determining the beginning of the notice period.

(e) Duty to Cooperate. SDARS licensees must cooperate in good faith in the selection and use of new repeater sites to reduce interference and make the most effective use of the authorized facilities. Licensees of stations suffering or causing harmful interference must cooperate in good faith and resolve such problems by mutually satisfactory arrangements. If the licensees are unable to do so, the International Bureau, in consultation with the Office of Engineering and Technology and the Wireless Telecommunications Bureau, may impose restrictions on SDARS licensees, including specifying the transmitter power, antenna height, or area or hours of operation of the stations.

For the reasons discussed above, the Federal Communications Commission amends Title 47 of the Code of Federal Regulations, Part 27, as follows:

PART 27 – MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES

1. The authority citation for Part 27 continues to read as follows:

Authority: 47 U.S.C. 154, 301, 302a, 303, 307, 309, 332, 336, and 337 unless otherwise noted.

2. Amend Section 27.14 by revising paragraph (a) and adding paragraph (p) to read as follows:

§ 27.14 Construction requirements; Criteria for renewal.

(a) AWS and WCS licensees, with the exception of WCS licensees holding authorizations for Block A in the 698–704 MHz and 728–734 MHz bands, Block B in the 704–710 MHz and 734–740 MHz bands, Block E in the 722–728 MHz band, Block C, C1, or C2 in the 746–757 MHz and 776–787 MHz bands, Block D in the 758–763 MHz and 788–793 MHz bands, Block A in the 2305-2310 MHz and 2350-2355 MHz bands, Block B in the 2310-2315 MHz and 2355-2360 MHz bands, Block C in the 2315-2320 MHz band, and Block D in the 2345-2350 MHz band, must, as a performance requirement, make a showing of “substantial service” in their license area within the prescribed license term set forth in § 27.13. “Substantial service” is defined as service which is sound, favorable and substantially above a level of mediocre service which just might minimally warrant renewal. Failure by any licensee to meet this requirement will result in forfeiture of the license and the licensee will be ineligible to regain it.

* * * * *

(p) This section enumerates performance requirements for licensees holding authorizations for Block A in the 2305-2310 MHz and 2350-2355 MHz bands, Block B in the 2310-2315 MHz and 2355-2360 MHz bands, Block C in the 2315-2320 MHz band, and Block D in the 2345-2350 MHz band.

(1) For mobile or point-to-multipoint systems, a licensee must provide reliable signal coverage and offer service to at least 40 percent of the license area's population by [42 MONTHS AFTER THE EFFECTIVE DATE OF ORDER], and to at least 75 percent of the license area's population by [72 MONTHS AFTER THE EFFECTIVE DATE OF ORDER]. If, when filing the construction notification required under § 1.946(d), a WCS licensee demonstrates that 25 percent or more of the license area's population for Block A, B or D is within a coordination zone as defined by section 27.73(a) of this rule part, the foregoing population benchmarks are reduced to 25 and 50 percent, respectively. The percentage of a license area's population within a coordination zone equals the sum of the Census Block Centroid Populations within the area, divided by the license area's total population.

(2) For point-to-point fixed systems, except those deployed in the Gulf of Mexico license area, a licensee must construct and operate a minimum of 15 point-to-point links per million persons (one link per 67,000 persons) in a license area by [42 MONTHS AFTER THE EFFECTIVE DATE OF ORDER], and 30 point-to-point links per million persons (one link per 33,500 persons) in a licensed area by [72 MONTHS AFTER THE EFFECTIVE DATE OF ORDER]. The exact link requirement is calculated by dividing a license area's total population by 67,000 and 33,500 for the respective milestones, and then rounding upwards to the next whole number. For a link to be counted towards these benchmarks, both of its endpoints must be located in the license area. If only one endpoint of a link is located in a license area, it can be counted as a one-half link towards the benchmarks.

(3) For point-to-point fixed systems deployed on any spectrum block in the Gulf of Mexico license area, a licensee must construct and operate a minimum of 15 point-to-point links by [42 MONTHS AFTER THE EFFECTIVE DATE OF ORDER], and a minimum of 15 point-to-point links by [72 MONTHS AFTER THE EFFECTIVE DATE OF ORDER].

(4) Under subsection (2) and (3) above, each fixed link must provide a minimum bit rate, in bits per second, equal to or greater than the bandwidth specified by the emission designator in Hertz (*e.g.*, equipment transmitting at a 5 Mb/s rate must not require a bandwidth of greater than 5 MHz).

(5) If an initial authorization for a license area is granted after [EFFECTIVE DATE OF ORDER], then the applicable benchmarks in subsections (1), (2) and (3) above must be met within 42 and 72 months, respectively, of the initial authorization grant date.

(6) Licensees must use the most recently available U.S. Census Data at the time of measurement to meet these performance requirements.

(7) Licensees must certify compliance with the applicable performance requirements by filing a construction notification with the Commission, within 15 days of the expiration of the relevant performance milestone, pursuant to § 1.946(d). Each construction notification must include electronic coverage maps, supporting technical documentation, and any other information as the Wireless Telecommunications Bureau may prescribe by Public Notice. Electronic coverage maps must accurately depict the boundaries of each license area (Regional Economic Area Grouping, REAG, or Major Economic Area, MEA) in the licensee's service territory. Further, REAG maps must depict MEA boundaries and MEA maps must depict Economic Area boundaries. If a licensee does not provide reliable signal coverage to an entire license area, its map must accurately depict the boundaries of the area or areas within each license area not being served. Each licensee also must file supporting documentation certifying the type of service it is providing for each REAG or MEA within its service territory and the type of technology used to provide such service. Supporting documentation must include the assumptions used to create the

coverage maps, including the propagation model and the signal strength necessary to provide reliable service with the licensee's technology.

(8) If a licensee fails to meet any applicable performance requirement, its authorization will terminate automatically without further Commission action as of the applicable performance milestone and the licensee will be ineligible to regain it.

3. Amend Section 27.50 by revising paragraph (a) to read as follows:

§ 27.50 Power limits and duty cycle.

(a) The following power limits and related requirements apply to stations transmitting in the 2305-2320 MHz band or the 2345-2360 MHz band.

(1) Base and fixed stations.

(i) For base and fixed stations transmitting in the 2305-2315 MHz band or the 2350-2360 MHz band:

(A) The average equivalent isotropically radiated power (EIRP) must not exceed 2,000 watts within any 5 megahertz of authorized bandwidth and must not exceed 400 watts within any 1 megahertz of authorized bandwidth.

(B) The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB. The PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR will not exceed 13 dB for more than 0.1 percent of the time or other Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

(ii) For base and fixed stations transmitting in the 2315-2320 MHz band or the 2345-2350 MHz band, the peak EIRP must not exceed 2,000 watts.

(iii) Base stations supporting frequency division duplex (FDD) mobile and portable operations are restricted to transmitting in the 2345-2360 MHz bands.

(2) Fixed customer premises equipment stations. For fixed customer premises equipment (CPE) stations transmitting in the 2305-2320 MHz band or in the 2345-2360 MHz band, the peak EIRP must not exceed 20 watts per 5-megahertz. Fixed CPE stations transmitting in the 2305-2320 MHz band or in the 2345-2360 MHz band must employ automatic transmit power control when operating so the stations operate with the minimum power necessary for successful communications. The use of outdoor antennas for CPE stations or outdoor CPE station installations operating with 2 watts per 5-megahertz or less average EIRP is prohibited. For WCS CPE using TDD technology, the duty cycle must not exceed 38 percent; for WCS CPE using FDD technology, the duty cycle must not exceed 12.5 percent in the 2315-2320 MHz band, and must not exceed 25 percent in the 2305-2315 MHz band.

(3) Mobile and portable stations.

(i) For mobile and portable stations transmitting in the 2305-2317.5 MHz band or the 2347.5-2360 MHz band, the average EIRP must not exceed 250 milliwatts within any 5 megahertz of authorized bandwidth and must not exceed 50 milliwatts within any 1 megahertz of authorized bandwidth. For mobile and portable stations using time division duplex (TDD) technology, the duty cycle must not exceed 38 percent in the 2305-2317.5 MHz and 2347.5-2360 MHz bands. For mobile and portable stations using frequency division duplex (FDD) technology, the duty cycle must not exceed 12.5 percent in the 2315-2317.5 MHz band and must not exceed 25 percent in the 2305-2315 MHz band. Mobile and portable stations using

FDD technology are restricted to transmitting in the 2305-2317.5 MHz band. Power averaging shall not include intervals in which the transmitter is off.

(ii) Mobile and portable stations are not permitted to operate in the 2317.5-2320 MHz and 2345-2347.5 MHz bands.

(iii) Automatic transmit power control. Mobile and portable stations transmitting in the 2305-2317.5 MHz band or in the 2347.5-2360 MHz band must employ automatic transmit power control when operating so the stations operate with the minimum power necessary for successful communications.

(iv) Prohibition on external vehicle-mounted antennas. The use of external vehicle-mounted antennas for mobile and portable stations transmitting in the 2305-2317.5 MHz band or the 2347.5-2360 MHz band is prohibited.

* * * * *

4. Amend Section 27.53 by revising paragraphs (a)(1), (a)(2), (a)(3), (a)(4), and (a)(5), removing and reserving paragraphs (a)(6) and (a)(9), and revising paragraph (a)(10) to read as follows:

§ 27.53 Emission limits.

(a) For operations in the 2305-2320 MHz band and the 2345-2360 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power P (with averaging performed only during periods of transmission) within the licensed band(s) of operation, in watts, by the following amounts:

(1) For base and fixed stations' operations in the 2305-2320 MHz band and the 2345-2360 MHz band:

(i) By a factor of not less than $43 + 10 \log(P)$ dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band of operation, and not less than $75 + 10 \log(P)$ dB on all frequencies between 2320 and 2345 MHz;

(ii) By a factor of not less than: $43 + 10 \log(P)$ dB at 2305 MHz, $70 + 10 \log(P)$ dB at 2300 MHz, $72 + 10 \log(P)$ dB at 2287.5 MHz, and $75 + 10 \log(P)$ dB below 2285 MHz;

(iii) By a factor of not less than: $43 + 10 \log(P)$ dB at 2360 MHz, $55 + 10 \log(P)$ dB at 2362.5 MHz, $70 + 10 \log(P)$ dB at 2365 MHz, $72 + 10 \log(P)$ dB at 2367.5 MHz, and $75 + 10 \log(P)$ dB above 2370 MHz.

(2) For fixed customer premises equipment (CPE) stations operating in the 2305-2320 MHz band and the 2345-2360 MHz band transmitting with more than 2 watts per 5-megahertz average EIRP:

(i) By a factor of not less than: $43 + 10 \log(P)$ dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band of operation, and not less than $75 + 10 \log(P)$ dB on all frequencies between 2320 and 2345 MHz.

(ii) By a factor of not less than: $43 + 10 \log(P)$ dB at 2305 MHz, $70 + 10 \log(P)$ dB at 2300 MHz, $72 + 10 \log(P)$ dB at 2287.5 MHz, and $75 + 10 \log(P)$ dB below 2285 MHz;

(iii) By a factor of not less than: $43 + 10 \log(P)$ dB at 2360 MHz, $55 + 10 \log(P)$ dB at 2362.5 MHz, $70 + 10 \log(P)$ dB at 2365 MHz, $72 + 10 \log(P)$ dB at 2367.5 MHz, and $75 + 10 \log(P)$ dB above 2370 MHz.

(3) For fixed CPE stations transmitting with 2 watts per 5-megahertz average EIRP or less:

(i) By a factor of not less than $43 + 10 \log (P)$ dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band of operation, not less than $55 + 10 \log (P)$ dB on all frequencies between 2320 and 2324 MHz and on all frequencies between 2341 and 2345 MHz, not less than $61 + 10 \log (P)$ dB on all frequencies between 2324 and 2328 MHz and on all frequencies between 2337 and 2341 MHz, not less than $67 + 10 \log (P)$ dB on all frequencies between 2328 and 2337 MHz;

(ii) By a factor of not less than $43 + 10 \log (P)$ dB at 2305 MHz, $55 + 10 \log (P)$ dB at 2300 MHz, $61 + 10 \log (P)$ dB at 2296 MHz, $67 + 10 \log (P)$ dB at 2292 MHz, $70 + 10 \log (P)$ dB below 2288 MHz.

(iii) By a factor of not less than: $43 + 10 \log (P)$ dB at 2360 MHz and $70 + 10 \log (P)$ dB above 2365 MHz.

(4) For mobile and portable stations operating in the 2305-2317.5 MHz and 2347.5-2360 MHz bands:

(i) By a factor of not less than: $43 + 10 \log (P)$ dB on all frequencies between 2305 and 2317.5 MHz and on all frequencies between 2347.5 and 2360 MHz that are outside the licensed band of operation, not less than $55 + 10 \log (P)$ dB on all frequencies between 2320 and 2324 MHz and on all frequencies between 2341 and 2345 MHz, not less than $61 + 10 \log (P)$ dB on all frequencies between 2324 and 2328 MHz and on all frequencies between 2337 and 2341 MHz, not less than $67 + 10 \log (P)$ dB on all frequencies between 2328 and 2337 MHz.

(ii) By a factor of not less than $43 + 10 \log (P)$ dB at 2305 MHz, $55 + 10 \log (P)$ dB at 2300 MHz, $61 + 10 \log (P)$ dB at 2296 MHz, $67 + 10 \log (P)$ dB at 2292 MHz, and $70 + 10 \log (P)$ dB below 2288 MHz.

(iii) By a factor of not less than: $43 + 10 \log (P)$ dB at 2360 MHz and $70 + 10 \log (P)$ dB above 2365 MHz.

(5) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1-MHz bands immediately outside and adjacent to the channel blocks at 2305, 2310, 2315, 2320, 2345, 2350, 2355, and 2360 MHz, a resolution bandwidth of at least 1 percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (*i.e.* 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. With respect to television operations, measurements must be made of the separate visual and aural operating powers at sufficiently frequent intervals to ensure compliance with the rules.

* * * * *

(6) Reserved.

* * * * *

(9) Reserved.

(10) The out-of-band emissions limits in paragraphs (a)(1) through (a)(3) of this section may be modified by the private contractual agreement of all affected licensees, who must maintain a copy of the agreement

in their station files and disclose it to prospective assignees, transferees, or spectrum lessees and, upon request, to the Commission.

* * * * *

5. Add Section 27.72 to read as follows:

§ 27.72 Information sharing requirements.

This section requires WCS licensees in the 2305-2320 MHz and 2345-2360 MHz bands to share information regarding the location and operation of base stations with Satellite Digital Audio Radio Service (SDARS) licensees in the 2320-2345 MHz band. Section 25.263 of this chapter requires SDARS licensees in the 2320-2345 MHz band to share information regarding the location and operation of terrestrial repeaters with WCS licensees in the 2305-2320 MHz and 2345-2360 MHz bands.

(a) WCS licensees must select base station sites and frequencies, to the extent practicable, to minimize the possibility of harmful interference to operations in the SDARS 2320-2345 MHz band.

(b) Prior Notice Periods. WCS licensees that intend to operate a base station must, before commencing such operation, provide 10 business days prior notice to all SDARS licensees. WCS licensees that intend to modify an existing base station must, before commencing such modified operation, provide 5 business days prior notice to all SDARS licensees. For the purposes of this section, a business day is defined by § 1.4(e)(2) of this chapter.

(c) Contents of Notice.

(1) Notification must be written (*e.g.*, certified letter, fax, or email) and include the licensee's name, and the name, address, and telephone number of its coordination representative, unless the SDARS licensee and all potentially affected WCS licensees reach a mutual agreement to provide notification by some other means. WCS licensees and SDARS licensees may establish such a mutually agreeable alternative notification mechanism without prior Commission approval, provided that they comply with all other requirements of this section.

(2) Regardless of the notification method, it must specify relevant technical details, including, at a minimum: (i) the coordinates of the proposed base station to an accuracy of no less than ± 1 second latitude and longitude; (ii) the proposed operating power(s), frequency band(s), and emission(s); (iii) the antenna center height above ground and ground elevation above mean sea level, both to an accuracy of no less than ± 1 meter; (iv) the antenna gain pattern(s) in the azimuth and elevation planes that include the peak of the main beam; and (v) the antenna downtilt angle(s).

(3) A WCS licensee operating base stations must maintain an accurate and up-to-date inventory of its base stations, including the information set forth in § 27.72(c)(2) of this chapter, which shall be available upon request by the Commission.

(d) Calculation of Notice Period. Notice periods are calculated from the date of receipt by the licensee being notified. If notification is by mail, the date of receipt is evidenced by the return receipt on certified mail. If notification is by fax, the date of receipt is evidenced by the notifying party's fax transmission confirmation log. If notification is by e-mail, the date of receipt is evidenced by a return e-mail receipt. If the SDARS licensee and all potentially affected WCS licensees reach a mutual agreement to provide notification by some other means, that agreement must specify the method for determining the beginning of the notice period.

(e) Duty to Cooperate. WCS licensees must cooperate in good faith in the selection and use of new station sites and new frequencies to reduce interference and make the most effective use of the authorized

facilities. WCS licensees should provide SDARS licensees as much lead time as practicable to provide ample time to conduct analyses and opportunity for prudent base station site selection prior to WCS licensees entering into real estate and tower leasing or purchasing agreements. WCS licensees must have sufficient operational flexibility in their network design to implement one or more technical solutions to remedy harmful interference. Licensees of stations suffering or causing harmful interference must cooperate in good faith and resolve such problems by mutually satisfactory arrangements. If the licensees are unable to do so, the Wireless Telecommunications Bureau, in consultation with the Office of Engineering and Technology and the International Bureau, will consider the actions taken by the parties to mitigate the risk of and remedy any alleged interference. In determining the appropriate action, the Bureau will take into account the nature and extent of the interference and act promptly to remedy the interference. The Bureau may impose restrictions on WCS licensees, including specifying the transmitter power, antenna height, or other technical or operational measures to remedy the interference, and will take into account previous measures by the licensees to mitigate the risk of interference.

6. Add Section 27.73 to read as follows:

§ 27.73 WCS, AMT, and Goldstone coordination requirements.

This section requires Wireless Communications Services (WCS) licensees in the 2345-2360 MHz band to coordinate the deployment of base stations with Aeronautical Mobile Telemetry (AMT) facilities in the 2360-2395 MHz band; and to take all practicable steps necessary to minimize the risk of harmful interference to AMT facilities.

(a) Wireless Communications Service (WCS) licensees operating base stations in the 2345-2360 MHz band shall, prior to operation of such base stations, achieve a mutually satisfactory coordination agreement with the Aerospace and Flight Test Radio Coordinating Council (AFTRCC) for any AMT receiver facility within 45 kilometers or the radio line of sight, whichever distance is larger, of the intended WCS base station location. This coordination is necessary to protect AMT receive systems consistent with Recommendation ITU-R M.1459. The locations of the current and planned Federal and non-Federal AMT receiver sites may be obtained from AFTRCC.

(b) WCS licensees operating base stations in the 2305-2320 MHz band shall, prior to operation of such base stations, achieve a mutually satisfactory coordination agreement with the National Aeronautics and Space Administration (NASA) within 145 kilometers of the Goldstone, CA earth station site (35-25-33 N 116-53-23 W).

(c) After base station operations commence, upon receipt of a complaint of harmful interference, the WCS licensee(s) receiving the complaint, no matter the distance from the NASA Goldstone, CA earth station or from an AMT site, operating in the 2305-2320 or 2345-2360 MHz bands, respectively, shall take all practicable steps to immediately eliminate the interference.

(d) Duty to Cooperate. WCS licensees, AFTRCC, and NASA must cooperate in good faith in the coordination and deployment of new facilities. WCS licensees must also cooperate in good faith in the selection and use of new station sites and new frequencies when within radio line of site of AMT receiver facilities to reduce the risk of harmful interference and make the most effective use of the authorized facilities. Licensees of stations suffering or causing harmful interference must cooperate in good faith and resolve such problems by mutually satisfactory arrangements. If the licensees are unable to do so, the Wireless Telecommunications Bureau, in consultation with the Office of Engineering and Technology and the National Telecommunications and Information Administration may impose restrictions including specifying the transmitter power, antenna height, or area or hours of operation of the stations.

APPENDIX C

Final Regulatory Flexibility Analysis

Report and Order in WT Docket No. 07-293

1. As required by the Regulatory Flexibility Act of 1980, as amended (RFA),¹ Initial Regulatory Flexibility Analyses (IRFA) were incorporated in the *Notice of Proposed Rulemaking (2007 Notice)*,² as well as the *WCS Performance Public Notice*³ in WT Docket No. 07-293. The Commission sought written public comment on the proposals in the *2007 Notice* and *WCS Performance Public Notice*, including comment on the IRFAs. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.⁴

A. Need for, and Objectives of, the *Report and Order*

2. In this *Report and Order*, the Commission takes a number of steps to facilitate deployment of mobile broadband products and services in the 2305-2320 MHz and 2345-2360 MHz Wireless Communications Service (WCS) bands, while safeguarding from harmful interference satellite radio services, which are provided in the interstitial 2320-2345 MHz Satellite Digital Radio Service (SDARS) band. These steps are set forth below in paragraphs 3-10.

3. In this *Report and Order*, the objective of the Commission is to resolve the issue of potential interference between the proposed simultaneous and potentially conflicting operations of SDARS and WCS licensees by establishing a regulatory framework that allows such licensees in the 2305-2360 MHz frequency band to co-exist. Specifically, the Commission revises certain power and out-of-band emissions (OOBE) rules applicable to WCS licensees.

4. *Mobile and Portable (Handheld) Power Limits.* Upon careful consideration of the technical analyses submitted in the record, the Commission revises the power limits for mobile and portable device operations in all WCS spectrum blocks. Noting that mobile handheld devices operating in other services typically employ up to approximately 250 milliwatts (mW) of power, the Commission establishes a power limit of 250 mW average equivalent isotropically radiated power (EIRP) limit for the WCS A and B blocks and for the lower 2.5 megahertz of the WCS C Block and the upper 2.5 megahertz of the WCS D Block, limited to 50 mW/MHz of EIRP. The *Report and Order*, however, prohibits WCS mobile and portable devices from operating in the upper 2.5 megahertz of the WCS C Block and the lower 2.5 megahertz of the WCS D block in light of the immediate adjacency of those blocks to the SDARS band. The Commission concludes that these restrictions are needed to provide added protection to SDARS receivers in the 2320-2345 MHz band.

¹ See 5 U.S.C. § 603. The RFA, see 5 U.S.C. § 601 – 612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

² See Amendment of Part 27 of the Commission's Rules to Govern the Operation of Wireless Communications Services in the 2.3 GHz Band and Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band, *Notice of Proposed Rulemaking and Second Further Notice of Proposed Rulemaking*, WT Docket No. 07-293 and IB Docket No. 95-91, 22 FCC Rcd 22123, 22156-22159 (2007) ("2007 Notice").

³ See "Federal Communications Commission Requests Comment on Revision of Performance Requirements for 2.3 GHz Wireless Communications Service," WT Docket No. 07-293, *Public Notice*, FCC 10-46 (rel. March 29, 2010) (*WCS Performance Public Notice*).

⁴ See 5 U.S.C. § 604. A Final Regulatory Flexibility Analysis of the *Second Report and Order* in IB Docket No. 95-91 is contained in a separate appendix.

5. *Mobile and Portable Emission Limits.* Noting that the existing $(110 + 10 \log(P))$ dB out-of-band emissions (OOBE) attenuation applicable to WCS mobile equipment⁵ is so restrictive such that, in effect, no mobile operation is feasible, the Commission lowers the applicable emission limits to provide WCS licensees greater flexibility. The *Report and Order* revises OOBE rules to require that a WCS mobile or portable device attenuate its output emissions below the transmitter power P by a factor of not less than $43 + 10 \log(P)$ dB in the 2305-2317.5 MHz and 2347.5-2360 MHz bands on frequencies that are outside the licensed band of operation, not less than $55 + 10 \log(P)$ dB in the 4 megahertz of SDARS spectrum nearest the WCS band (*i.e.*, 2320-2324 MHz and 2341-2345 MHz), $61 + 10 \log(P)$ dB in the center four megahertz of each SDARS assignment (2324-2328 MHz and 2337-2341 MHz), and $67 + 10 \log(P)$ dB in the spectrum shared by SDARS operators (2328-2337 MHz). These revised OOBE limits are intended to minimize the potential for interference to satellite radio users in the vast majority of circumstances, while enabling WCS licensees to deliver vital mobile broadband services to the public. To limit the potential for interference to Deep Space Network (DSN) operations in the 2290-2300 MHz band and Aeronautical Mobile Telemetry (AMT) operations in the 2360-2395 MHz band, WCS mobile and portable devices OOBE must be attenuated by a factor of not less than $43 + 10 \log(P)$ dB at 2305 and 2360 MHz, not less than $55 + 10 \log(P)$ dB at 2300 MHz, not less than $61 + 10 \log(P)$ dB at 2296 MHz, not less than $67 + 10 \log(P)$ dB at 2292 MHz, and not less than $70 + 10 \log(P)$ dB below 2288 MHz and above 2365 MHz.

6. *Base and Fixed Station Power and OOBE Limits.* In order to appropriately balance the interests of both SDARS and WCS, the Commission concludes that base and fixed station power limits for the WCS C and D blocks should not be revised. Because of the proximity of the C and D blocks to the SDARS band, the Commission agrees with SDARS licensees that the current 2,000 Watts (W) peak EIRP limit applicable to these blocks should be retained. However, the *Report and Order* revises the power limit for base and fixed station operations in WCS Blocks A and B from the current 2,000 Watts peak EIRP limit to 2,000 W over five megahertz (400 W/MHz), which will be measured on an average basis with a maximum peak-to-average power ratio (PAPR) of 13 dB. This approach, combined with the 250 mW average EIRP limit for WCS mobile and portable devices and the related OOBE limit for emissions into the SDARS band, will provide the technical flexibility for WCS licensees in these blocks to deploy much needed broadband services to the public with minimal impact on satellite radio users.

7. Additionally, in the *Report and Order*, the Commission also seeks to provide WCS licensees with greater flexibility with regard to emission limits by adopting an OOBE attenuation factor of $75 + 10 \log(P)$ dB below the transmitter power P , as measured over a 1-megahertz resolution bandwidth, for WCS base stations, on frequencies in the SDARS band at 2320-2345 MHz. In addition, to protect DSN operations in the 2290-2300 MHz band and AMT operations in the 2360-2395 MHz band, WCS base and fixed stations' OOBE must be attenuated by a factor of not less than $43 + 10 \log(P)$ dB at 2305 and 2360 MHz, not less than $55 + 10 \log(P)$ dB at 2362.5 MHz, not less than $70 + 10 \log(P)$ dB at 2300 and 2365 MHz, not less than $72 + 10 \log(P)$ dB at 2287.5 and 2367.5 MHz, and not less than $75 + 10 \log(P)$ dB below 2285 MHz and above 2370 MHz.

8. *Fixed Customer Premises Equipment (CPE) Power and OOBE Limits.* In the *Report and Order*, the Commission maintains the current mobile transmitter power limit of 20 W per 5-megahertz peak EIRP for WCS fixed CPE devices. The Commission notes that there have not been any significant reports of interference to SDARS operations resulting from currently authorized equipment, and does not expect SDARS operations to experience any appreciable increase in interference from these WCS operations if the current limit is retained. Moreover, the Commission believes that continuing to allow WCS fixed CPE devices to use up to 20 W per 5-megahertz EIRP will enhance the provision and quality of service in rural areas, where subscribers are often located significant distances from WCS licensees' serving base stations.

⁵ See 47 C.F.R. § 27.53(a)(2).

9. Additionally, the Commission adopts, for WCS fixed CPE devices operating above 2 Watts per 5-megahertz average transmit power, an OOB attenuation factor of not less than $75 + 10 \log (P)$ dB, as measured over a 1-megahertz resolution bandwidth, on frequencies in the 2320-2345 MHz band, not less than $43 + 10 \log (P)$ dB on all frequencies between 2305 and 2320 MHz and between 2345 and 2360 MHz that are outside the licensed band of operation, not less than $43 + 10 \log (P)$ dB at 2305 and 2360 MHz, not less than $55 + 10 \log (P)$ dB at 2362.5 MHz, not less than $70 + 10 \log (P)$ dB at 2300 and 2365 MHz, not less than $72 + 10 \log (P)$ dB at 2287.5 and 2367.5 MHz, and not less than $75 + 10 \log (P)$ dB below 2285 MHz and above 2370 MHz.

10. For lower power CPE devices operating at or below 2 W per 5-megahertz average EIRP, the Commission further relaxes the OOB attenuation levels measured over a 1-megahertz resolution bandwidth to the levels it adopts for mobile devices: not less than $43 + 10 \log (P)$ dB in the 2305-2320 MHz and 2345-2360 MHz bands on all frequencies that are outside the licensed band of operation, not less than $55 + 10 \log (P)$ dB in the 2320-2324 MHz and 2341-2345 MHz bands, not less than $61 + 10 \log (P)$ dB in the 2324-2328 MHz and 2337-2341 MHz bands, not less than $67 + 10 \log (P)$ dB in the 2328-2337 MHz band, not less than $43 + 10 \log (P)$ dB at 2305 and 2360 MHz, not less than $55 + 10 \log (P)$ dB at 2300 MHz, not less than $61 + 10 \log (P)$ dB at 2296 MHz, not less than $67 + 10 \log (P)$ dB at 2292 MHz, and not less than $70 + 10 \log (P)$ dB below 2288 MHz and above 2365 MHz.

11. *Notification Requirement.* The *Report and Order* adopts new rule Section 27.72, which will require WCS licensees to notify, and share certain technical information with, SDARS licensees 10 business days prior to commencing operation of a base station and five business days prior to commencing operation of a modified base station, to avoid potential interference to SDARS operations. The *Report and Order* also requires WCS licensees to provide SDARS licensees an inventory of their deployed infrastructure consistent with, and within 30 days of the effective date of, new Section 27.72.

12. *Protection of Deep Space Network and Aeronautical Mobile Telemetry Operations.* Further, the Commission adopts measures to protect Deep Space Network (DSN) operations in the 2290-2300 MHz band, as well as Aeronautical Mobile Telemetry (AMT) operations in the 2360-2395 MHz band. To protect DSN operations in the 2290-2300 MHz band, the *Report and Order* adopts a combination of reasonable OOB limits and a coordination distance of 145 km for WCS base stations. Similarly, the Commission also adopts revised OOB limits for emissions into the 2360-2395 MHz band, and requires WCS licensees to coordinate with AMT entities in circumstances where a WCS base station is within 45 kilometers or line of sight from an AMT receiver, whichever distance is greater. The Commission finds that these measures provide appropriate protection for operations below 2305 MHz and above 2360 MHz yet give WCS licensees sufficient flexibility to deploy mobile broadband services.

13. *WCS Performance Requirements.* The Commission also adopts enhanced performance requirements, which will further the public interest by promoting the rapid deployment of new broadband services to the American public. Specifically, WCS licensees providing mobile or point-to-multipoint services must provide reliable signal coverage to 40 percent of a license area's population within 42 months, and 75 percent of a license area's population within 72 months. Further, the *Report and Order* requires that WCS licensees deploying point-to-point fixed services construct and operate 15 point-to-point links per million persons in a license area within 42 months, and 30 point-to-point links per million persons in a license area within 72 months, together with a minimum payload capacity.

14. The Commission establishes alternative performance requirements for license areas where WCS licensees providing mobile or point-to-multipoint services must coordinate with aeronautical mobile telemetry (AMT) entities to serve a significant percentage of a market's total population. Specifically, in any license area where 25 percent or more the population is within an AMT zone, affected licensees must serve 25 percent (rather than 40) of the population within 42 months, and 50 percent

(rather than 75) within 72 months. Because it will be easier to coordinate point-to-point systems in the vicinity of AMT receive sites, the *Report and Order* does not find it necessary to reduce the applicable construction thresholds for point-to-point facilities.

B. Summary of Significant Issues Raised by Public Comments in Response to the IRFA

15. No comments were received in response to the IRFAs in the *2007 Notice* and the *WCS Performance Public Notice*.

C. Description and Estimate of the Number of Small Entities To Which the Rules Will Apply

16. The RFA directs agencies to provide a description of and, where feasible, an estimate of the number of small entities that may be affected by the rules adopted. The RFA generally defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”⁶ In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.⁷ A small business concern is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).⁸ A small organization is generally “any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.”⁹ Below, the Commission further describes and estimates the number of small entity licensees and regulatees that may be affected by the rules changes explored in the *Notices*.

17. *WCS Licensees.* The Wireless Communication Service in the 2305-2360 MHz (2.3 GHz) frequency band has flexible rules that permit licensees in this service to provide fixed, mobile, portable, and radiolocation services. Licensees are also permitted to provide satellite digital audio radio services. The SBA rules establish a size standard for “Wireless Telecommunications Carriers,” which encompasses business entities engaged in radiotelephone communications employing no more than 1,500 persons.¹⁰ There are currently 155 active WCS licenses held by 10 licensees. Of these, 7 licensees qualify as small entities and hold a total of 50 licenses.

18. *RF Equipment Manufacturers.* The Census Bureau defines this category as follows: “This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.”¹¹ The SBA has developed a small business size standard for Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing, which is: all such firms having

⁶ See 5 U.S.C. § 601(6).

⁷ See 5 U.S.C. § 601(3) (incorporating by reference the definition of “small business concern” in 15 U.S.C. § 632). Pursuant to the RFA, the statutory definition of a small business applies unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register.

⁸ See Small Business Act, 5 U.S.C. § 632 (1996).

⁹ See 5 U.S.C. § 601(4).

¹⁰ See 13 C.F.R. § 121.201, NAICS code 517110

¹¹ U.S. Census Bureau, 2002 NAICS Definitions, “334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing”; <http://www.census.gov/epcd/naics02/def/NDEF334.HTM#N3342>.

750 or fewer employees.¹² According to Census Bureau data for 2002, there were a total of 1,041 establishments in this category that operated for the entire year.¹³ Of this total, 1,010 had employment of under 500, and an additional 13 had employment of 500 to 999.¹⁴ Thus, under this size standard, the majority of firms can be considered small.

D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities

19. The *Report and Order* imposes certain changes in projected reporting, record keeping, and other compliance requirements. These changes affect small and large companies equally. With respect to coordination requirements in circumstances where WCS licensees are within certain distances from AMT operations, the *Report and Order* requires WCS and AMT entities to cooperate in good faith in order to minimize the likelihood of harmful interference, make the most effective use of facilities, as well as to resolve actual instances of harmful interference. The *Report and Order* also requires coordinating parties to share accurate and relevant information in a timely and efficient manner. Parties unable to reach a mutually acceptable coordination agreement may approach the Wireless Telecommunications Bureau, which, in cooperation with the Office of Engineering and Technology and the National Telecommunications & Information Administration (NTIA), may impose restrictions on operating parameters such as the transmitter power, antenna height, or area or hours of operation of the stations. Deadlines may also be imposed if it appears that parties are unable to reach a mutually acceptable arrangement within a reasonable time period.

20. The *Report and Order* requires that WCS licensees demonstrate compliance with any revised performance requirements by filing a construction notification within 15 days of the relevant benchmark and certifying that they have met the applicable performance requirements. The *Report and Order* requires that each construction notification should include electronic coverage maps and supporting documentation, which must be truthful and accurate and must not omit material information that is necessary for the Commission to determine compliance with its performance requirements. Further, the electronic coverage maps must clearly and accurately depict the boundaries of each license area (Regional Economic Area Grouping, REAG, or Major Economic Area, MEA) in the licensee's service territory, with REAG maps depicting MEA boundaries, and MEA maps depicting Economic Area boundaries. The *Report and Order* provides that if the licensee's signal does not provide service to the entire license area, the map must clearly and accurately depict the boundaries of the area or areas within each license area not being served. These procedures direct each licensee to file supporting documentation certifying the type of service it is providing for each REAG or MEA within its license service territory and the type of technology it is utilizing to provide such service. Further, the compliance procedures require the supporting documentation to provide the assumptions used to create the coverage maps, including the propagation model and the signal strength necessary to provide service with the licensee's technology.

¹² See 13 C.F.R. § 121.201, NAICS code 334220.

¹³ U.S. Census Bureau, American FactFinder, 2002 Economic Census, Industry Series, Industry Statistics by Employment Size, NAICS code 334220 (released May 26, 2005); <http://factfinder.census.gov>. The number of "establishments" is a less helpful indicator of small business prevalence in this context than would be the number of "firms" or "companies," because the latter take into account the concept of common ownership or control. Any single physical location for an entity is an establishment, even though that location may be owned by a different establishment. Thus, the numbers given may reflect inflated numbers of businesses in this category, including the numbers of small businesses. In this category, the Census breaks-out data for firms or companies only to give the total number of such entities for 2002, which were 929.

¹⁴ *Id.* An additional 18 establishments had employment of 1,000 or more.

21. Other than these requirements, as well as the notification obligations discussed in Section A, *supra*, there are no other specific reporting or recordkeeping requirements adopted in the *Report and Order*.

E. Steps Taken to Minimize Significant Economic Impact on Small Entities, and Significant Alternatives Considered

22. The RFA requires an agency to describe any significant alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives: (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for small entities; (3) the use of performance, rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities.¹⁵

23. The Commission's principal objective in this proceeding is to enable the provision of promising mobile broadband services to the public in the WCS spectrum to the maximum extent practicable, while ensuring that satellite radio operations are not unreasonably impacted by the Commission's actions. Adopting overly stringent technical rules for WCS to protect SDARS operations from interference will preclude WCS mobile operation, while liberalizing the WCS rules too much will result in harmful interference and disruption to SDARS service. Such results would cause significant adverse economic impact on either WCS licensees, which include small entities, or on SDARS operations.¹⁶ Accordingly, the Commission has considered various alternatives, as described below, in order to best provide WCS licensees, including small-entity WCS licensees, with the flexibility to provide mobile service, while also protecting against disruptions to SDARS operations due to harmful interference.

24. *Mobile and Portable (Handheld) Device Power Limits.* In response to the 2007 Notice's request for comment regarding applicable mobile and portable device power limits, the WCS Coalition argues that, in conjunction with the use of certain OOB limits (described below), mobile and portable devices should be permitted to operate at a maximum of 250 mW average EIRP, and subject to the use of transmit power control mechanisms. In contrast, SDARS licensees initially proposed that WCS mobile and portable devices operating on WCS Blocks A and B should be limited to 10 mW EIRP, and that mobile and portable devices operating in WCS Blocks C and D should be limited to 1 mW EIRP. More recently, Sirius XM Radio, Inc., a SDARS licensee,¹⁷ advocates that no change be made to current technical restrictions for mobile and portable devices on the C and D blocks. After a review of the technical analyses submitted by the parties, the Commission determines that a power level of 250 mW average EIRP for Blocks A and B and for the lower 2.5 megahertz of the WCS C Block and upper 2.5 megahertz of the WCS D Block, limited to 50 mW/MHz of EIRP, using ATPC and subject to the OOB limit discussed below, should allow adequate user reception of satellite radio, while also enabling WCS licensees, including small entities, to provide valuable mobile services to the public. Further, the Commission believes that prohibiting mobile and portable devices from transmitting in the 2.5 megahertz portions of the WCS C and D Blocks closest to the SDARS band will further limit the potential for harmful interference to SDARS receivers in the 2320-2345 MHz band. The Commission believes that its overall approach strikes the appropriate balance between the WCS Coalition's request that the Commission adopt a 250 mW average EIRP limit for mobile and portable stations in WCS Blocks A and B and the 2.5 megahertz portions of WCS Blocks C and D furthest from the SDARS band, and its

¹⁵ See 5 U.S.C. § 603(c).

¹⁶ There are no satellite radio licensees that are considered small entities for the purposes of the RFA.

¹⁷ Sirius XM Radio, Inc. (Sirius XM), formerly Sirius Satellite Radio, Inc.

reduced stepped power levels for WCS Blocks C and D, and SDARS licensees' proposals for the WCS band.

25. *Mobile and Portable Device Out-of-Band Emission Limits.* In the 2007 Notice, the Commission asked interested parties to address how the WCS industry would be affected if the Commission were to retain the current out-of-band emission (OOBE) limits of $110 + 10 \log(P)$ dB for mobile and portable devices, and whether the limit should be revised. In response, the WCS Coalition argues that the current limit is too restrictive, and proposes that the Commission adopt stepped OOBE limits of $55 + 10 \log(P)$ dB in the 2320-2324 MHz/2341-2345 MHz bands, $61 + 10 \log(P)$ dB in the 2324-2328 MHz/2337-2341 MHz bands, and $67 + 10 \log(P)$ dB in the 2328-2337 MHz band. Another WCS licensee, NextWave Wireless (NextWave), advocates relaxing the OOBE limit to $60 + 10 \log(P)$ dB, while Sirius XM proposes an emission limit of $86 + 10 \log(P)$ dB.

26. Based on its review of the record in this proceeding, the Commission determines that it should require that WCS mobile and portable devices' OOBE be attenuated below the transmitter power P by a factor of not less than $43 + 10 \log(P)$ dB in the 2305-2317.5 MHz and 2347.5-2360 MHz bands on frequencies that are outside the licensed band of operation, not less than $55 + 10 \log(P)$ dB in the 2320-2324 MHz and 2341-2345 MHz bands, by $61 + 10 \log(P)$ dB in the 2324-2328 MHz and 2337-2341 MHz bands, and by $67 + 10 \log(P)$ dB in the 2328-2337 MHz band. In addition, mobile and portable devices' OOBE must be attenuated by a factor of not less than $43 + 10 \log(P)$ dB at 2305 and 2360 MHz, not less than $55 + 10 \log(P)$ dB at 2300 MHz, not less than $61 + 10 \log(P)$ dB at 2296 MHz, not less than $67 + 10 \log(P)$ dB at 2292 MHz, and not less than $70 + 10 \log(P)$ dB below 2288 and above 2365 MHz. In adopting these factors, the Commission believes that these limits will help avoid significant adverse economic impact to both the WCS industry, as well as SDARS operations by enabling WCS licensees to provide mobile services that were not viable under the existing rules, and by permitting SDARS licensees to continue to operate without undue interference from the WCS band. In addition, these OOBE attenuation factors will limit the potential for interference to Deep Space Network (DSN) operations in the 2290-2300 MHz band and Aeronautical Mobile Telemetry operations in the 2360-2395 MHz band. In adopting the stepped OOBE limits, the Commission declines to adopt Sirius XM's request for a more restrictive OOBE limit because such limit would effectively preclude WCS licensees, including small entities, from deploying mobile service. The Commission also finds that the proposal by the WCS Coalition will provide greater overall protection to SDARS operations than the $60 + 10 \log(P)$ dB advocated by NextWave. Accordingly, adoption of the above-specified stepped OOBE limits into the applicable portions of the 2320-2345 MHz SDARS band best minimizes significant economic impacts on small, as well as larger, entities.

27. *Base Station Power Limits.* In the 2007 Notice, the Commission sought comment on the WCS Coalition's proposal that it revise the existing 2,000 W (2 kW) EIRP peak power limit with a 2 kW EIRP average power limit for WCS fixed and base stations. The Commission asked interested parties to address what impact, if any, adoption of an average, rather than peak, power limit for WCS would have on the ability of WCS licensees to deploy new services. In response, the WCS Coalition reiterates its support of a 2 kW EIRP average power limit, and states that applying a power limit on an average vs. peak basis will provide greater interference protection to SDARS operations. In contrast, SDARS licensees argue that applying an average power limit is not supported, and that such use will quadruple the amount of harmful interference to SDARS receivers. Sirius XM prefers the use of ground-level emission limits to govern transmitting facilities, but would accept retaining existing power limits measured on a peak basis, or other traditional power restrictions that offer sufficient protection to SDARS.

28. Based on its analysis of the record and a balancing of its objectives in this proceeding, the Commission adopts, in part, the WCS Coalition's proposal regarding base station power limits for WCS Blocks A and B, and also adopts in part Sirius XM's proposal regarding base station power limits in WCS Blocks C and D. The Commission finds that it is appropriate to modify the WCS Blocks A and B base station limit to 2 kW EIRP over 5 megahertz (400 W/MHz), which will be measured on an average basis

with a maximum peak-to-average power ratio (PAPR) of 13dB. The Commission finds that these measures will adequately protect SDARS operations, and concludes that the ground-level emission limits sought by Sirius XM would be overly complex and burdensome for WCS licensees, including small entities, to comply with.

29. However, while the Commission concludes that adopting the WCS proposal is desirable with respect to the A and B blocks, it retains the power limits for WCS operations in the C and D blocks at 2,000 watts peak EIRP. Because base station operations in WCS Blocks C and D inherently pose more risk of potential interference to satellite radio users than would base station operations in Blocks A and B, which are separated from the SDARS spectrum by at least 5 megahertz, the Commission considers maintaining the current limits appropriate in order to minimize interference into satellite radio operations.

30. The Commission expects that both approaches, combined with the 250 mW average EIRP limit for WCS mobile and portable devices and the related OOB attenuation factors of not less than $43 + 10 \log (P)$ dB in the 2305-2317.5 MHz and 2347.5-2360 MHz bands on frequencies that are outside the licensed band of operation, not less than $55 + 10 \log (P)$ dB in the 2320-2324 MHz/2341-2345 MHz bands, $61 + 10 \log (P)$ dB in the 2324-2328 MHz/ 2337-2341 MHz bands, and $67 + 10 \log (P)$ dB in the 2328-2337 MHz band, and not less than $43 + 10 \log (P)$ dB at 2305 and 2360 MHz, not less than $55 + 10 \log (P)$ dB at 2300 MHz, not less than $61 + 10 \log (P)$ dB at 2296 MHz, not less than $67 + 10 \log (P)$ dB at 2292 MHz, and not less than $70 + 10 \log (P)$ dB below 2288 and above 2365 MHz should provide the technical flexibility for WCS licensees to deploy mobile service, and thereby avoid the adverse economic impact to WCS licensees, including small entities, that would occur without the ability to provide such service.

31. *Base and Fixed Station OOB Limits.* In the *2007 Notice*, the Commission sought comment on whether Sirius' proposal for a requirement to limit ground-level emissions would facilitate the deployment of both SDARS and WCS services to the public. The Commission also sought comment in the *2007 Notice* on the WCS Coalition's proposal to require both WCS and SDARS licensees to attenuate base stations' OOB by a factor of $75 + 10 \log (P)$ dB, as measured over a 1-megahertz resolution bandwidth. In its comments on the *2007 Notice*, the WCS Coalition reiterated its support for the $75 + 10 \log (P)$ dB attenuation requirement. Sirius XM also supported relaxing the OOB attenuation requirement for WCS base stations to $75 + 10 \log (P)$ dB but with a ground-level emissions limits of 100 dB μ V/m for WCS Blocks A and B and 90 dB μ V/M for WCS Blocks C and D.

32. The Commission finds it in the public interest to adopt an OOB attenuation factor of $75 + 10 \log (P)$ dB, measured over a 1-megahertz resolution bandwidth, for WCS base and fixed stations on frequencies in the 2320-2345 MHz band. Both WCS and SDARS licensees urge us to lower the current $80 + 10 \log (P)$ dB OOB attenuation factor by 5 dB. Although Sirius XM also requests that we establish ground-level emission limits, we decline to adopt ground-level emission limits for WCS base stations as proposed by Sirius XM because of the difficulties associated with characterizing and quantifying the case-specific propagation environment's effects on an RF signal's field strength that could influence the interference potential at each fixed site. The rules that would result from an attempt to deal with the anomalies associated with field strength levels, moreover, would be overly complex and difficult for licensees to comply with and would be difficult, at best, for the Commission to enforce. Furthermore, we believe that the revised power limits that we are establishing, together with a $75 + 10 \log (P)$ dB OOB attenuation factor, will provide SDARS operations reasonable interference protection while affording WCS licensees additional flexibility to offer mobile services to the public. To protect DSN and AMT operations, we find it is the public interest to adopt an OOB attenuation factor of not less than $43 + 10 \log (P)$ dB at 2305 and 2360 MHz, not less than $55 + 10 \log (P)$ dB at 2362.5 MHz, not less than $70 + 10 \log (P)$ dB at 2300 and 2365 MHz, not less than $72 + 10 \log (P)$ dB at 2287.5 and 2367.5 MHz, and not less than $75 + 10 \log (P)$ dB below 2285 MHz and above 2370 MHz.

33. *Fixed Customer Premises Equipment (CPE) Power and OOB Limits.* The *Report and Order* also resolves power and OOB limits proposals relating to WCS fixed CPE devices. The WCS Coalition requests that the Commission apply to WCS fixed CPE operations a power limit of 20 W average EIRP, and an OOB attenuation of $75 + 10 \log (P)$ dB. For WCS fixed CPE devices transmitting at no greater than 2 W average transmitter output power, the WCS Coalition proposes the same stepped OOB limit that it proposes for mobile devices. Sirius XM, on the other hand, proposes that WCS fixed CPE devices operating above 2 W EIRP be subject to ground level-based emission limits, and proposes that all WCS fixed CPE devices' OOB be attenuated by $75 + 10 \log (P)$ dB regardless of the device's operating power.

34. The Commission finds it appropriate to maintain the current mobile transmitter power limit of 20 W per 5-megahertz peak EIRP for WCS fixed CPE devices because it appears that the existing limit has not resulted in interference to SDARS operation and also provides WCS licensees with operational flexibility. Also, for WCS CPE operating with an EIRP above 2 W per 5-megahertz, the Commission adopts the $75 + 10 \log (P)$ dB OOB attenuation factor for frequencies in the 2320-2345 MHz band, noting that both SDARS and WCS licensees propose that limit, and SDARS licensees have indicated that they are amenable to a lowering of the OOB limit because WCS fixed CPE device operations pose less risk of interference and disruption to SDARS licensees. Further, in light of the Commission's finding that applying the stepped OOB limits to WCS mobile and portable devices will provide sufficient protection to SDARS operations, as well as the lower likelihood of interference to SDARS receivers posed by WCS fixed CPE terminals operating at or below 2 Watts per 5-megahertz, the Commission finds it appropriate to adopt the stepped OOB limit that is applicable to WCS mobile devices (*i.e.*, $43 + 10 \log (P)$ dB in the 2305-2317.5 MHz and 2347.5-2360 MHz bands on frequencies that are outside the licensed band of operation, $55 + 10 \log (P)$ dB in the 2320-2324 MHz/2341-2345 MHz bands, $61 + 10 \log (P)$ dB in the 2324-2328 MHz/ 2337-2341 MHz bands, and $67 + 10 \log (P)$ dB in the 2328-2337 MHz band, and not less than $43 + 10 \log (P)$ dB at 2305 and 2360 MHz, $55 + 10 \log (P)$ dB at 2300 MHz, $61 + 10 \log (P)$ dB at 2296 MHz, $67 + 10 \log (P)$ dB at 2292 MHz, and $70 + 10 \log (P)$ dB below 2288 MHz and above 2365 MHz) for these WCS CPE as well.

35. *Notification Requirement.* In the 2007 Notice, the Commission invited comment regarding the extent to which SDARS and WCS licensees should be required to coordinate deployments of repeaters and base stations, respectively. Sirius XM supports a 90-day notice requirement. Although WCS licensees support measures to encourage SDARS and WCS licensees to share certain technical information, they oppose the adoption of a 90-day notice process. The Commission agrees with SDARS licensees that the public interest will be served by requiring SDARS and WCS licensees to notify each other prior to deploying or modifying repeaters or base stations, respectively, but believes that a 90-day notice requirement as proposed by SDARS licensees to be unduly burdensome. Accordingly, the Commission will require WCS and SDARS licensees to share certain technical information at least 10 business days before operating a new base station or repeater, and at least five business days before modifying an existing facility. The Commission believes that adopting the streamlined notification requirements rather than the 90-day prior coordination requirement previously advocated by Sirius XM will enable SDARS and WCS licensees to minimize the potential for harmful interference between their services while also reducing administrative as well as economic burdens on all parties.

36. *Protection of DSN and AMT Operations.* The *Report and Order* establishes revised OOB and coordination rules where WCS base stations are within certain distances from DSN and AMT operations. The Commission imposes these requirements in recognition of the possible effects that WCS operations may have on DSN and AMT entities, which use sensitive receivers and high gain antennas to receive often weak signals. The *Report and Order* concludes that the adoption of reasonable OOB and coordination requirements will adequately protect DSN and AMT operations while enabling WCS entities to construct and operate new broadband systems. The Commission has reviewed alternatives submitted by commenters, which, for example, variously call for both more and less stringent OOB limits and

coordination distances than those that are being adopted. The Commission concludes, however, that the requirements that it is adopting best balance the interests of the interested parties.

37. *WCS Performance Requirements.* Further, in this *Report and Order*, the Commission adopts revised performance requirements for WCS. The enhanced construction rules the Commission is adopting replace the substantial service requirement previously placed on WCS licensees with specific population-based benchmarks. In recognition of difficulties that may arise in license areas where WCS licensees must coordinate their facilities with AMT receive sites, the *Report and Order* reduces the level of construction required in such markets. The Commission seeks to establish a buildout requirement that is reasonable and achievable for WCS licensees, including small entities, but which encourages rapid and meaningful deployment of mobile broadband services. The Commission has considered alternative performance benchmarks, including requirements using shorter timeframes, and lower percentages of required construction. However, the Commission concludes that other alternatives would not strike the appropriate balance. Further, with respect to the performance rules, all WCS entities will be required to file construction notifications to inform the Commission that they have successfully met the performance requirements described above. The Commission has reviewed whether there should be other requirements, such as a formal procedure in which comment would be sought from the public regarding the construction showings filed by licensees. The Commission determines, however, that it is not necessary to include other requirements to the adopted construction notification procedure.

38. **Report to Congress:** The Commission will send a copy of the Report and Order, including this FRFA, in a report to be sent to Congress pursuant to the Congressional Review Act.¹⁸ In addition, the Commission will send a copy of the Report and Order, including this FRFA, to the Chief Counsel for Advocacy of the SBA. A copy of the Report and Order and FRFA (or summaries thereof) will also be published in the Federal Register.

¹⁸ See 5 U.S.C. § 801(a)(1)(A).

APPENDIX D

Final Regulatory Flexibility Certification

Second Report and Order in IB Docket No. 95-91

1. The Regulatory Flexibility Act of 1980, as amended (RFA)¹ requires that a regulatory flexibility analysis be prepared for rulemaking proceedings, unless the agency certifies that "the rule will not have a significant economic impact on a substantial number of small entities."² The RFA generally defines "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."³ In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.⁴ A small business concern is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).⁵

2. The rules adopted in this Second Report and Order affect providers of Satellite Digital Audio Radio Service (SDARS). With respect to providers of SDARS, *i.e.* providers of a nationally distributed subscription radio service, no small entities are affected by the rules adopted in this Second Report and Order. SDARS is a satellite service. The SBA has established a size standard for "Satellite Telecommunications," which is that any large satellite services provider must have an annual revenue of \$15.0 million.⁶ Currently, only a single operator, Sirius XM Radio Inc. ("Sirius XM"), holds licenses to provide SDARS, which requires a great investment of capital for operation. Sirius XM has annual revenues in excess of \$15.0 million.⁷ Because SDARS requires significant capital, we believe it is unlikely that a small entity as defined by the Small Business Administration would have the financial wherewithal to become an SDARS licensee.

3. Therefore, since only one large entity is affected by the rules adopted in this Second Report and Order, we certify that the requirements of the Second Report and Order will not have a significant economic impact on a substantial number of small entities. The Commission will send a copy of the Second Report and Order, including a copy of this final certification, in a report to Congress pursuant to the Small Business Regulatory Enforcement Fairness Act of 1996, see 5 U.S.C. § 801(a)(1)(A). In addition, the Second Report and Order and this certification will be sent to the Chief Counsel for Advocacy of the Small Business Administration, and will be published in the Federal Register. See 5 U.S.C. § 605(b).

¹ The RFA, see 5 U.S.C. S 601 *et. seq.*, has been amended by the Contract With America Advancement Act of 1996, Public Law No. 104-121, 110 Stat. 847 (1996) (CWAAA). Title II of the CWAAA is the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA).

² 5 U.S.C. 605(b).

³ 5 U.S.C. 601(6).

⁴ 5 U.S.C. 601(3) (incorporating by reference the definition of "small business concern" in Small Business Act, 15 U.S.C. S 632). Pursuant to 5 U.S.C. 601(3), the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register."

⁵ Small Business Act, 15 U.S.C. S 632.

⁶ See 13 CFR 121.201, NAICS code 517410.

⁷ Sirius XM reported annual revenue of over \$2.47 billion in 2009. *See* Sirius XM Radio Inc., SEC Form 10-K at 25 (filed Feb. 25, 2010).

APPENDIX E

Description of WCS/SDARS Testing in Ashburn, Virginia (July 28-29, 2009)

1. The WCS Coalition provided two four-door sedans for the Ashburn tests. One sedan was equipped with a permanently-installed (OEM) Sirius satellite radio receiver and a portable (aftermarket) Sirius satellite radio receiver. The other sedan was equipped with a permanently-installed XM satellite radio receiver and a portable XM satellite radio receiver. Both vehicles had satellite radio antennas installed on the centerline of the roof just forward of the rear window, with the antenna for the portable receiver magnetically mounted between the rear window and the permanently-installed antenna. The WCS WiMAX mobile signal was generated by an Alvarion, Ltd. (Alvarion) PCMCIA card plugged into a notebook computer.¹ The notebook computer ran software that could generate WiMAX traffic at programmable rates, simulating voice and file-transfer modes, and could also monitor and record statistics on WiMAX traffic that was transmitted by a WiMAX base station also provided by Alvarion. Similar software was also run on the WCS WiMAX base station. The WiMAX base station included two directional panel antennas located near the southwest corner of the roof of the building at 44675 Cape Ct., Ashburn, VA, at an elevation of approximately 7 to 8 meters above the ground. The base station antennas were oriented toward the northeast. The WCS WiMAX mobile device and base station were operated in time-division duplex (“TDD”) mode, and were tuned to frequencies in the upper A and lower B blocks for tests with the Sirius receivers, and to a frequency centered on the boundary of the D and A blocks for tests with XM receivers, and to a frequency centered on the boundary of the B and C blocks for additional tests with Sirius receivers.

2. During the drive tests on the first day of testing (July 28, 2009), both WCS Coalition sedans were driven around a test route located primarily on Beaumeade Circle in Ashburn, VA, with short segments on Loudoun County Parkway and in the parking lot surrounding the base station location. The distance from the WiMAX base station to the most distant point on the test route was approximately 440 meters, and the minimum distance was less than 20 meters. The two vehicles were driven at speeds up to about 25 miles per hour. The vehicles remained within a maximum distance of few car lengths of each other, and passed each other several times along the test route. Depending on the pre-planned test scenario being executed, the notebook computer containing the WCS mobile device was held either on the operator’s lap, to simulate laptop use by an occupant of the vehicle, or at head level, to simulate the use of a WCS mobile telephone.

3. The WCS Coalition representatives ran two types of tests: one simulating a high-bandwidth download, in which the WCS mobile device transmitter duty cycle was approximately 25 percent, and another simulating a voice over Internet Protocol (VoIP) telephone call, with a much lower transmitter duty cycle. A total of six configurations for the WCS mobile device were tested; a drive test for each configuration was performed at least once; and a few of the configurations were drive tested two or more times. Some of the WCS Coalition’s tests were run with the WCS mobile device using automatic transmitter power control, and some were run with the WCS mobile device transmitting at a fixed power level of 250 mW (24 dBm). To test the effect of a WCS mobile device’s out-of-band emissions, during one test, the WCS signal was centered at 2347.5 MHz and only out-of-band emissions were transmitted from the WCS mobile device. The WCS Coalition has submitted a test matrix that shows the combinations of frequencies, Sirius and XM receivers, WiMAX traffic types, WCS mobile

¹ The Alvarion, Ltd. PC card emissions accurately represented WiMAX in-band signals, but exceeded the WCS Coalition’s proposed out-of-band emissions mask. The WCS Coalition has not provided to the Commission the transmitted spectrum measurements of the Alvarion PC card or base station emissions, or the power level of the base station transmitter.

device positioning, and WCS mobile device transmitter power that were used during the drive tests.² After observing tests with the WiMAX base station and mobile transmitting in the upper A block without any muting of the SDARS signal occurring, Commission staff requested that certain test cases expected to produce worst-case interference scenarios be run, with the understanding that if these cases resulted in prolonged muting of the SDARS receivers, then it would be appropriate to run test cases expected to produce less interference to the SDARS receivers.

4. Sirius XM demonstrated outdoor and indoor tests on the second day of the Ashburn tests (July 29, 2009). Satellite radio signals and a low-level terrestrial repeater signal were available at the test site. During the morning session, Sirius XM demonstrated interference into SDARS receivers from their WCS signal simulator. This simulator comprised a laboratory-equipment-based WCS signal and out-of-band noise generator mounted in the trunk of a four-door sedan, with a cable running from the front passenger seat and connected to an antenna.³ An occupant of this vehicle held the transmitting antenna at lap or ear height, depending on the test scenario being demonstrated. Sirius XM provided another sedan with a factory installed XM satellite radio receiver. For the first portion of the morning session, the sedan containing the WCS signal simulator remained stationary at a location in the parking lot on the north side of the Homewood Suites building at 44620 Waxpool Road, Ashburn, VA. The sedan carrying the satellite radio receiver was driven up and down an aisle of the parking lot to find a distance between the two sedans at which satellite radio signal muting would occur. Sirius XM summarized the results of the portion of these tests with the simulated WCS signal operating in the WCS D-block in a table in the Engineering Appendix of its August 3, 2009, *Ex Parte* filing.⁴ For the second portion of the morning session, both vehicles were parked adjacent to the building in order to block reception of one of the XM satellite signals.

5. During the afternoon session on the second day of testing, Sirius XM demonstrated interference into an XM receiver equipped for diagnostics and having an antenna module with a signal input port that allowed it to be connected via a cable to the test equipment. For this test, Sirius XM used simulated satellite signals generated by special test equipment and simulated WCS interfering signals generated by laboratory test equipment.⁵ Sirius XM demonstrated the effects of varying simulated WCS frequency offsets and signal power levels during both the morning and afternoon sessions. Sirius XM summarized the results of these tests in tabular form in Exhibit A of the Engineering Appendix of its August 3, 2009, *Ex Parte* filing.⁶

² Letter from Mary N. O'Connor, Counsel to the WCS Coalition, to Marlene H. Dortch, Secretary, FCC (filed August 4, 2009) at Exhibit A p. 2 (*WCS-SDARS Demonstration, Test Matrix*).

³ This equipment setup is described on page 2 of the Engineering Appendix to Sirius XM's *Ex Parte* letter dated August 3, 2009. Letter from Terrence R. Smith, Corporate VP and Chief Engineering Officer and James R. Blitz, Vice President, Regulatory Counsel, of Sirius XM Radio Inc. to Marlene H. Dortch, Secretary, FCC (filed August 3, 2009), Engineering Appendix at 2.

⁴ *Id.* at Engineering Appendix at 10.

⁵ This equipment setup is described on pages 10-11 of the Engineering Appendix to Sirius XM's *Ex Parte* letter dated August 3, 2009. *Id.* at Engineering Appendix at 10-11.

⁶ *Id.* at Engineering Appendix at 13-16.

APPENDIX F

**Applications for Additional Time to Meet the 2.3 GHz
Wireless Communications Service Substantial Service Performance Requirement**

| Applicant Name | Call Sign | File Number | Receipt Date |
|---|-----------|-------------|--------------|
| CELLUTEC | KNLB242 | 0003852958 | 5/29/2009 |
| CELLUTEC | KNLB216 | 0003852962 | 5/29/2009 |
| NTELOS Inc. | KNLB243 | 0003854302 | 6/1/2009 |
| NW Spectrum Co. | KNLB200 | 0003855239 | 6/1/2009 |
| NW Spectrum Co. | KNLB213 | 0003855241 | 6/1/2009 |
| NW Spectrum Co. | KNLB217 | 0003855243 | 6/1/2009 |
| NW Spectrum Co. | KNLB206 | 0003855240 | 6/1/2009 |
| NW Spectrum Co. | KNLB218 | 0003855244 | 6/1/2009 |
| NW Spectrum Co. | KNLB292 | 0003855248 | 6/1/2009 |
| NW Spectrum Co. | KNLB293 | 0003855249 | 6/1/2009 |
| NW Spectrum Co. | KNLB322 | 0003855251 | 6/1/2009 |
| NW Spectrum Co. | KNLB323 | 0003855252 | 6/1/2009 |
| NW Spectrum Co. | KNLB294 | 0003855250 | 6/1/2009 |
| NW Spectrum Co. | KNLB255 | 0003855247 | 6/1/2009 |
| NW Spectrum Co. | KNLB215 | 0003855242 | 6/1/2009 |
| NW Spectrum Co. | KNLB219 | 0003855245 | 6/1/2009 |
| NW Spectrum Co. | KNLB220 | 0003855246 | 6/1/2009 |
| Unrestricted Subsidiary Funding Company | WPSL357 | 0003879254 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPSL350 | 0003879247 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPSL358 | 0003879255 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPSL351 | 0003879248 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPSL352 | 0003879249 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPSL359 | 0003879256 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPSL353 | 0003879250 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPSL360 | 0003879257 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPSL354 | 0003879251 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | KNLB232 | 0003879244 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPSL361 | 0003879258 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPSL355 | 0003879252 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | KNLB235 | 0003879245 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPSL362 | 0003879259 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPSL356 | 0003879253 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | KNLB205 | 0003879243 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPYP769 | 0003879261 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | KNLB291 | 0003879246 | 6/23/2009 |
| Unrestricted Subsidiary Funding Company | WPYP768 | 0003879260 | 6/23/2009 |
| WaveTel NC License Corporation | WPZA813 | 0003854544 | 6/1/2009 |
| WaveTel NC License Corporation | WPZA811 | 0003854803 | 6/1/2009 |
| WaveTel NC License Corporation | WPZA810 | 0003854841 | 6/1/2009 |
| WaveTel NC License Corporation | WPZA812 | 0003854706 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB208 | 0003855280 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB302 | 0003855288 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB303 | 0003855289 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB304 | 0003855290 | 6/1/2009 |

| Applicant Name | Call Sign | File Number | Receipt Date |
|--------------------------------------|------------------|--------------------|---------------------|
| WCS Wireless License Subsidiary, LLC | KNLB305 | 0003855291 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB306 | 0003855292 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB207 | 0003855279 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB307 | 0003855293 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB295 | 0003855281 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB296 | 0003855282 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB308 | 0003855294 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB297 | 0003855283 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB298 | 0003855284 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB299 | 0003855285 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB300 | 0003855286 | 6/1/2009 |
| WCS Wireless License Subsidiary, LLC | KNLB301 | 0003855287 | 6/1/2009 |