

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of)	
)	
AT&T Mobility Spectrum LLC; BellSouth)	
Mobile Data, Inc.; New Cingular Wireless)	RM-11731
PCS, LLC; and SBC Telecom Inc.)	
)	
Petition for Rulemaking Amending)	
WCS Technical Standards Rules)	

To: The Commission

COMMENTS OF AT&T

AT&T Mobility Spectrum LLC; BellSouth Mobile Data, Inc.; New Cingular Wireless PCS, LLC; and SBC Telecom Inc. (together with their ultimate parent, AT&T Inc., and its other affiliates, “AT&T”) hereby offer comments in support of their Petition for Rulemaking to amend certain Part 27 rules governing the C and D Blocks of the Wireless Communications Services in the 2.3 GHz band (the “WCS band”).¹ As described in the Petition, the proposed rule changes will enable AT&T to use its C and D Block spectrum for the air-to-ground component of its planned LTE-based in-flight connectivity service for airlines and passengers.² In addition, the proposed rules – with the adjustments described below – include restrictions on transmitter power levels, limits on out-of-band emissions (“OOBE”), and specific requirements for

¹ *AT&T Mobility Spectrum LLC, BellSouth Mobile Data, Inc., New Cingular Wireless PCS, LLC; and SBC Telecom Inc. Petition for Rulemaking Amending WCS Technical Standards Rules*, Petition for Rulemaking, RM-11731 (filed Aug. 8, 2014) (“Petition”). The Commission sought comments on the Petition on August 21, 2014, *Wireless Telecommunications Bureau Seeks Comment on AT&T Petition for Rulemaking Regarding Revision of WCS Rules*, Public Notice, RM-11731, DA 14-1210 (WTB, rel. Aug. 21, 2014).

² See Press Release, AT&T Inc., Mobilizing the Sky: AT&T Building 4G LTE In-Flight Connectivity Service, available at http://about.att.com/story/mobilizing_the_sky_att_building_4g_lte_in_flight_connectivity_service.html (Apr. 28, 2014) (“*Mobilizing the Sky*”).

coordination with Sirius XM Radio Inc. (“Sirius XM”), in order to protect adjacent spectrum users from harmful interference.³

I. Adjustments to Proposed Rule Changes

AT&T and Sirius XM have begun preliminary testing of air-to-ground equipment using WCS spectrum. This initial testing has indicated that the proposed rules will protect Sirius XM sufficiently from harmful interference, provided that the following additional changes are made to those specifications:

- In certain circumstances, locating a base station to be used for ground-to-air transmissions in proximity to a base station operating in the WCS A or B Blocks was found to create interference to satellite radio. Consequently, AT&T proposes to add the following subparagraph (C) to Section 27.50(a)(1)(ii):

(C) A WCS licensee seeking to locate or relocate base or fixed stations in this band shall coordinate with each Satellite Digital Audio Radio Service (“SDARS”) licensee prior to providing commercial service from any such facility. After this process, in any remaining areas of potential interference identified by an SDARS licensee, a base station transmitting in the 2345-2350 MHz band shall be located at least 1 km from all base stations transmitting in the 2305-2315 MHz band and the 2350-2360 MHz bands in a rural morphology or 0.5 km in an urban or suburban morphology; provided, however, such a base station may be located closer than these distances from a base station transmitting in the 2305-2315 MHz band and the 2350-2360 MHz band if the ground signal level is no greater than -55 dBm in the 2305-2315 MHz and the 2350-2360 MHz bands. Rural, suburban, and urban morphologies are as defined by the modified COST231 propagation model with correction factors $K_c = -2, -12, \text{ and } -20$ for urban, suburban, and rural morphologies, respectively, and as further defined in the 2010 U.S. Census. *See* <https://www.census.gov/geo/reference/urban-rural.html> (as of Sept. 20, 2014). The COST231 model may be found at: European Cooperation in the Field of Scientific and Technical Research, EURO-COST 231, “Digital Mobile Radio Towards Future Generation Systems,” COST 231 Final report, available at <http://www.lx.it.pt/cost231/> (as of Sept. 20,

³ Petition at 4-9 (discussing proposed Sections 27.4, 27.14(p)(3), 27.50(a)(1)(ii), 27.50(a)(3)(i), 27.50(a)(3)(ii), 27.50(a)(3)(v), 27.53(a)(5), 27.53(a)(10), 27.72(f)).

2014). In the event of ambiguity or disagreement, the RF channel characteristics as provided will make the final determination of area.

- Allowing a total average EIRP per avionics station of 1 watt at or above 1,000 feet above ground level (“AGL”) and below 3,000 feet AGL was found to have the potential to cause harmful interference. Consequently, AT&T hereby revises the language for the proposed new Section 27.50(a)(3)(v) to read as follows:

(v) Avionics stations may operate at up to 8 watts average EIRP per transmitter, with total average EIRP per avionics station not to exceed 16 watts at 20,000 feet above ground level (“AGL”) and above, 8 watts at or above 10,000 feet AGL and below 20,000 feet AGL, 1 watt at or above 3,000 feet AGL and below 10,000 feet AGL, and 0.25 watt below 3,000 feet AGL and on the ground.

- As the permitted EIRP of avionics stations decreases at varying altitude levels, the OOB levels of those stations needs to decrease as well. AT&T therefore adds the following subparagraph (iii) to proposed Section 27.53(a)(5):

(iii) OOB power levels for each transmitter should be reduced proportionately as Avionics Station power is reduced from 16 watts to 0.25 watt.

Sirius XM and AT&T believe that the proposed rules, as modified above, and the further provisions of their “Coordination Agreement and Interference Protection Between AT&T and Sirius XM for WCS C & D Blocks”⁴ (the “Coordination Agreement”) should protect Sirius XM’s satellite radio service from harmful interference.

II. The Proposed Rules Will Serve the Public Interest

Adopting the proposed rules will serve the public interest by enabling use of the WCS band C and D Blocks for an important new service without causing harmful interference to adjacent bands. In its 2012 *Order on Reconsideration*, the Commission expressly contemplated

⁴ The Coordination Agreement is being submitted today in this docket. See Joint Letter of AT&T Inc. and Sirius XM Radio Inc. (filed Sept. 22, 2014).

that licensees' plans for using the WCS C and D Blocks – including a potential air-to-ground service – likely would require fitting a square peg into a round hole: “[G]iven the wide range of deployments and applications possible, we find that WCS licensees should seek guidance from the Wireless Telecommunications Bureau on a case-by-case basis in determining whether their service is permissible within the C and D Blocks, and which benchmarks apply.”⁵ Implicit in this statement is a recognition that licensees might need further relief to fulfill the public interest in using this spectrum for innovative services. Here, amending the rules as proposed will permit the rapid, robust, nationwide deployment of innovative broadband services in the WCS band “while limiting their potential to cause harmful interference . . . to other adjacent bands [sic] services”⁶ or to the co-channel spectrum user, RigNet, Inc. (“RigNet”).⁷ It would, therefore, serve the public interest for the Commission to adopt the proposed rules.

III. AT&T’s Planned In-Flight Service Requires Higher Power Levels

To meet 3GPP WCS band LTE performance parameters in an air-to-ground application, AT&T’s link budget analysis has shown that base station transmit power levels must be comparable to those used in terrestrial WCS band LTE networks. For both terrestrial mobile applications and air-to-ground applications, received signal power at the cell edge is equal to the transmitter power plus the transmitter antenna gain plus the receiver antenna gain minus the total

⁵ *Amendment of Part 27 of the Comm’n’s Rules to Govern the Operation of Wireless Commc’ns Servs. in the 2.3 GHz Band*, Order on Reconsideration, 27 FCC Rcd 13,651, 13,702 ¶ 126 (2012) (“[W]e note that certain entities have sought guidance as to the specific performance requirements that would be applied to current or potential operations in the C and D Blocks that do not fall within the traditional mobile, point-to-multipoint, or point-to-point fixed models. For example, Gogo, Inc. seeks clarification as to whether ground-to-air uplinks could be deployed in the C and D Blocks, and what coverage requirements would apply.”).

⁶ *Id.* at 13,658 ¶ 11; *see, e.g., id.* at 13,652, 13,657-58 ¶¶ 2, 10, 12.

⁷ RigNet holds the A, B, C, and D Block Licenses in the Gulf of Mexico, and leases AT&T’s WCS spectrum in adjacent territorial waters. RigNet provides the oil and gas industry with managed communications and other network-based services.

losses in the path or $P_R = P_T + G_T + G_R - L_T$ where P_R is the received signal power, P_T is the transmitter power, G_T is the transmitter antenna gain, G_R is the receiver antenna gain, and L_T is the total path loss.⁸ Total path loss includes free space loss, diffraction loss (losses due to hills, etc.), and clutter or land use loss (trees, parks, buildings, etc.). Receiver sensitivities for both terrestrial mobile and air-to-ground applications are comparable.⁹ AT&T projects that the receiver and transmitter antenna gains for both terrestrial mobile and air-to-ground applications also are comparable, so the transmitter power needed to yield an acceptable signal at the receiver depends on the total path loss for the application in question.

Paths in terrestrial mobile applications range from one kilometer to eight kilometers. The free space losses for these paths are from 99.7 to 117.7 dB with an average free space loss of 108.7 dB. Diffraction losses in terrestrial mobile applications range from 6 to 25 dB with an average diffraction loss of 15.5 dB, and clutter losses in terrestrial mobile applications range from 10 to 20 dB with an average clutter loss of 15 dB. The average total loss in terrestrial mobile applications is 139.2 dB.

By contrast, path lengths for air-to-ground applications are between 75 and 150 kilometers, and the free space losses for these paths are from 136.7 to 142.7 dB. However, since paths in air-to-ground applications are line-of-sight, the diffraction losses and clutter losses for these paths are both 0 dB. As a result, the average total loss for air-to-ground applications is 139.7 dB.

⁸ This analysis is based on the Friis Transmission Equation, which is a means of calculating signal power at the receiver. The Friis Transmission Equation assumes a line-of-sight path between the transmitter and the receiver, so it must be modified to account for diffraction loss and clutter or land use loss. See Curt A. Levis, et. al, *Radiowave Propagation Physics and Application* 77 (2010).

⁹ Terrestrial mobile and air-to-ground receivers use the same chipset, developed according to 3GPP standards.

Because this average total loss for air-to-ground applications is virtually the same as the average total loss in terrestrial mobile applications (139.7 dB vs. 139.2 dB), comparable power levels are required to yield an acceptable signal level at the respective receivers. Thus, AT&T has proposed EIRP limits for ground-to-air base stations in the D Block that match the existing rules for terrestrial base stations in the WCS A and B Blocks.¹⁰

IV. AT&T Will Protect Sirius XM, RigNet, and AFTRCC from Harmful Interference

None of Sirius XM, RigNet, or the aeronautical mobile telemetry community will suffer harmful interference to its operations from AT&T's in-flight connectivity service.

With the changes discussed in Part I above and the other provisions of the Coordination Agreement, the proposed rule changes will protect Sirius XM from Harmful Interference, as that term is defined in Section 27.64(d) of the rules.¹¹ As determined by testing, and reflected by Section 27.64(d),¹² Harmful Interference to Sirius XM receivers occurs when the input interference power level from the WCS C or D Blocks is -55 dBm or greater. AT&T's proposed revisions to the rules will ensure its service does not exceed this level. AT&T's proposed transmitter OOB power levels at the antenna terminal for the WCS C Block spectrum will be -25 dBm for two MHz into the Sirius XM SDARS spectrum¹³ and -35 dBm for the remaining ten MHz.¹⁴ The composite power level in the four MHz filter passband of the Sirius XM receiver

¹⁰ See 47 C.F.R. § 27.50(a)(1).

¹¹ *Id.* § 27.64(d).

¹² *Id.*

¹³ $55 + 10\text{Log}(P) = -25 \text{ dBm/MHz}$.

¹⁴ $65 + 10\text{Log}(P) = -35 \text{ dBm/MHz}$.

closest to the WCS spectrum will be -21.5 dBm,¹⁵ and the antenna gain of the transmitter antenna for the service on the aircraft will be 0 dB. With these levels, for an aircraft at 10,000 feet AGL, AT&T's calculations show the received interference level at a Sirius XM receiver would be -131 dBm,¹⁶ which is much lower than the recognized -55 dBm Harmful Interference level. Similarly, for an aircraft at 1,000 meters or 3280 feet AGL, the received interference level at a Sirius XM receiver would be -121 dBm,¹⁷ also much lower than the -55 dBm Harmful Interference level. Even for an aircraft only 12 feet away from a Sirius XM receiver (an unlikely situation), the received interference level at the Sirius XM receiver would be -72 dBm,¹⁸ again below the -55 dBm Harmful Interference level. As a result, AT&T and Sirius XM expect that the proposed power levels will provide ample protection for Sirius XM's operations.

In addition, AT&T is cooperating with RigNet to identify technical and commercial solutions to ensure that AT&T's in-flight connectivity service will not cause harmful interference to RigNet's operations. Similarly, AT&T is engaged in discussions with Aerospace and Flight Test Radio Coordinating Council, Inc. ("AFTRCC"), regarding the proposed service and will coordinate with AFTRCC to ensure there is no harmful interference to aeronautical mobile telemetry facilities.

¹⁵ The passband of Sirius XM receiver filters is roughly 4 MHz wide. $-25 \text{ dBm} = 0.0032 \text{ mW} \times 2 \text{ MHz} = 0.0064$. $-35 \text{ dBm} = 0.000316 \text{ mW} \times 2 = 0.000632 \text{ mW}$. $0.000632 + 0.0064 = 0.007032 \text{ mW}$. $10\text{Log}(0.007032) = -21.5 \text{ dBm}$.

¹⁶ $P_R = P_T + G_T + G_R - \text{FSL} = -21.5 + 0 + 0 - 32.4 - 20\text{Log}(2320) - 20\text{Log}[(10,000/3.28)/1000] = -21.5 - (32.4 + 67.3 + 9.68) = -131 \text{ dBm}$.

¹⁷ $P_R = P_T + G_T + G_R - \text{FSL} = -21.5 + 0 + 0 - 32.4 - 20\text{Log}(2320) - 20\text{Log}[1] = -21.5 - (32.4 + 67.3 + 0) = -121 \text{ dBm}$.

¹⁸ $P_R = P_T + G_T + G_R - \text{FSL} = -21.5 + 0 + 0 - 32.4 - 20\text{Log}(2320) - 20\text{Log}[(12/3.28)/1000] = -21.5 - (32.4 + 67.3 - 48.73) = -72 \text{ dBm}$.

V. AT&T's Proposed Service Will Provide the Required Protection to Canadian and Mexican Spectrum Users

Through careful network design, AT&T will ensure that its air-to-ground system does not exceed the emission limits across the borders of Mexico and Canada.¹⁹ First, in many areas close to the borders, there are limited or no flight routes. Therefore, coverage is needed for these areas, no sites will be deployed there, and cross-border emissions will not be a concern.

Second, in areas close to the border where there are flight routes, cross-border emissions will be minimized through a careful site-selection and site-configuration design approach. When designing its in-flight-connectivity network, AT&T will take the following steps to ensure that the network will comply with border coordination requirements:

- **Coverage objectives.** AT&T's network design will target only domestic flight routes. International flight routes, especially those that are cross-border to Mexico or Canada, are not being targeted.
- **Site selection.** Only sites from which the cross-border coverage can be contained will be used in the network designs.
- **Antenna selection and configuration.** On sites closer to a border, antennas with narrower horizontal beamwidths will be used as much as possible to limit emissions across the border. For sites that are very close to a border, the antennas generally will not be configured to point towards the border, and the complete coverage footprint of these sites will be reduced from the conventional 360 degrees around the site in most cases.
- **Antenna uptilt.** For sites that are relatively close to a border, but for which network design requires antennas pointing at least partially towards the border, AT&T will utilize a higher antenna uptilt (resulting in a reduced cell radius) to reduce the signal strength at the border to acceptable limits.

VI. The Proposed Buildout Requirements Are Aggressive and Appropriate

AT&T has proposed a construction benchmark that is appropriate for an air-to-ground service.²⁰ The current buildout requirements for the WCS band spectrum were not adopted with

¹⁹ *See id.* § 27.57(a).

²⁰ AT&T has not proposed altering the buildout deadline in the existing rules.

an air-to-ground service in mind. They currently require that a licensee “provide reliable signal coverage and offer service to at least 40 percent of the license area’s population by March 13, 2017, and to at least 75 percent of the license area’s population by September 13, 2019.”²¹ The “population” coverage metric does not fit an air-to-ground network, which will provide service not to individuals on the ground, but to airplanes in the sky. Accordingly, AT&T has proposed that licensees using the spectrum for air-to-ground systems would need to “construct and operate Base Stations that provide robust, uninterrupted service to all routes within the contiguous United States among 50 or more airports classified as large or medium hubs (as measured by the FAA’s Final Calendar Year 2012 passenger enplanement data) by March 13, 2017.”²²

This proposed rule matches the buildout requirements proposed by the FCC in its recent Notice of Proposed Rulemaking regarding the establishment of an air-to-ground service in the 14.0-14.5 GHz band.²³ It also is more aggressive, in both the pace and extent of the buildout, than the requirements for the 800 MHz Air-Ground Radiotelephone Service band.²⁴

AT&T expects to exceed this benchmark by a substantial measure, ultimately planning to deploy a network of approximately 400 base stations. Nevertheless, from the time it launches

²¹ 47 C.F.R. § 27.14(p)(1).

²² Petition at 5.

²³ *Expanding Access to Broadband and Encouraging Innovation Through Establishment of an Air-Ground Mobile Broadband Secondary Service for Passengers Aboard Aircraft in the 14.0-14.5 GHz Band*, Notice of Proposed Rulemaking, 28 FCC Rcd 6765, 6788-89 ¶¶ 77-78 (2013) (proposing a “safe harbor” for “[t]he construction and operation of base stations that provide robust, uninterrupted service to all routes within the contiguous United States between 50 or more airports classified as large or medium hubs (as measured by the most recent FAA data for annual passenger enplanements) within ten years of license grant”).

²⁴ See 47 C.F.R. § 22.873(b) (providing that licensees could show “substantial service” within five years by “(1) construction and operation of 20 ground stations, with at least one ground station located in each of the 10 Federal Aviation Administration regions; or, (2) provision of service to the airspace of 25 of the 50 busiest airports (as measured by annual passenger boardings)”).

the service, AT&T intends to provide ubiquitous coverage over the 48 contiguous states from 10,000 feet to typical cruising altitude.

VII. Conclusion

With the proposed air-to-ground service, AT&T has found a way to put the C and D Block spectrum to productive use without infringing upon its spectral neighbors. This in-flight connectivity service will result in a robust, rapid, and nationwide deployment of facilities using the WCS C and D Blocks, while avoiding the interference problems that have bedeviled past efforts to use this spectrum intensively. Amending Part 27 of the rules as proposed in the Petition will permit the deployment of this innovative service. It would, therefore, serve the public interest for the Commission to grant AT&T's Petition for Rulemaking.

Respectfully submitted,

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