Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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 No. 8610

REPLY COMMENTS OF THE WCS COALITION

Paul J. Sinderbrand
Mary N. O'Connor

Wilkinson Barker Knauer, LLP
2300 N Street, NW
Suite 700
Washington, DC 20037-1128
202.783.4141

Its Attorneys

March 17, 2008

TABLE OF CONTENTS

I. INTRODUCTION. 1

II. DISCUSSION. 7

A. Test Results And Analysis Support Loosening The WCS Spectral Mask Into The 2320-2345 MHz Band For Low Power User Devices Employing Transmit Power Control... 7

B. The Substantially Increased SDARS Ground Level Signal Strength Limit That XM And Sirius Now Propose Would Effectively Preclude Two-Way Usage Of The WCS Band. 15

1. XM And Sirius Again Fail To Address The Interference WCS Base Stations Would Suffer From SDARS Repeaters. 18

2. SDARS's Proposed Ten-Fold Increase In Repeater Power Would Subject WCS User Equipment To Unreasonable Levels Of Interference. 23

3. If The Commission Does Impose A Field Strength Limit To Govern SDARS Interference To WCS, It Must Assure Appropriate Protection To WCS. 26

C. Imposition Of The Signal Strength Limits On WCS Licensees That Sirius And XM Propose Would Adversely Impact WCS Service Offerings. 30

D. Adoption Of The Power Restrictions Proposed For WCS Mobile And Portable Devices Would Effectively Preclude Viable Two-Way Services In The Band. 37

E. The Commission Should Permit Average Measurement Of The 2000 Watt EIRP Limit For WCS. 41

F. Having Accepted The Risks Associated With Constructing High-Power Terrestrial Repeaters Over WCS Objections, XM And Sirius Should Be Required To Bring Repeaters That Do Not Meet The New Rules Into Compliance..... 45

G. The Commission Should Reject The Proposal By AFTRCC To Require WCS Licensees To Attenuate Their Signals By At Least 110 + 10 Log (P) Above 2360 MHz. 50

III. CONCLUSION. 55

EXECUTIVE SUMMARY

In responding to the *Notice*, the two SDARS licensees do what they have consistently done – engage in recrimination, obfuscation, misdirection, and overreaching to subjugate the WCS band to SDARS in perpetuity. XM and Sirius proffer a revisionist history in which WCS was created as a secondary service, consigned to accept whatever interference SDARS throws its way while obligated to make whatever sacrifices are necessary to assure that no SDARS subscriber ever suffers even unperceivable interference. They abandon even the masquerade of compromise that had cloaked recent filings, and instead now advance a regulatory scheme designed to crush any prospect for WCS to satisfy the growing public demand for wireless broadband services. Yet, the Commission has left no doubt that the desire for a high quality SDARS must "be balanced with the need to provide reasonable operating parameters for adjacent services" and thus its objective in governing WCS is "to limit the potential for interference to a reasonable level – not to provide a pure, interference-free environment." The *Notice* makes clear that the Commission's objective in this proceeding is to craft rules "that would allow SDARS terrestrial repeaters and WCS operation to coexist in adjacent bands,"an objective XM and Sirius ignore. By contrast, the WCS Coalition offers solutions that achieve the Commission's objectives by reducing to manageable levels the interference between SDARS and WCS.

<u>WCS Can Be Afforded OOBE Relief Without Increased OOBE Interference To SDARS</u>. While SDARS has provided the Commission with no field studies of the vulnerability of their devices to OOBE interference, the WCS Coalition is presenting the results of *recent field testing that demonstrates that the Commission can safely adopt the WCS Coalition's proposal to apply a less restrictive spectral mask on low-powered WCS user devices that employ transmit power control*.

<u>The Ground Level Signal Strength SDARS Proposes For Itself Would Effectively Preclude WCS From Being Used For Two-Way Cellularized Services</u>. Although XM and Sirius had previously advocated a 100 dBµV/m ground level signal strength limit for their own repeater signals, they now purport require *ten times* the power and seek a 110 dBµV/m ground level signal strength limit. While the WCS Coalition established fundamental flaws with SDARS's initial proposal in its comments, their latest proposal only exacerbates those flaws. Once again, XM and Sirius ignore that allowing SDARS to transmit at such high levels threatens crippling interference to WCS base stations, which are typically located far above ground level and thus receive stronger interfering signals that receivers that benefit from the clutter closer to the ground. Were the Commission to adopt the latest XM and Sirius proposal under a reasonable deployment scenario the SDARS field strength at a WCS base station antenna could easily be 140 dBµV/m – *4,000 times stronger that what a WCS base station receiver can tolerate without likely risk of interference*!

Similarly, XM and Sirius are wrong in their assessment of the impact that their proposal would have on WCS user devices. Their analysis is wrong, largely because they presume that the overload point for such devices will be -35 dBm when in fact testing has shown it will likely be more on the order of -44 dBm. Moreover, their argument that WCS receivers should be able

to withstand overload from SDARS repeaters since XM and Sirius receivers do not suffer overload from each other misses one rather salient point – prior to their agreement to merge, Sirius was complaining bitterly to the Commission regarding the overload interference it was suffering at XM's hand.

If the Commission is disposed to adopt a ground level signal strength for SDARS, a maximum of 104 dBµV/m measured thirty meters above ground at any distance beyond the radiation center height above ground level from the base of the SDARS repeater antenna would be a reasonable compromise. An alternative that is easier to implement would be to restrict SDARS terrestrial field strength to 64 dBµV/m measured two meters above ground level at any distance beyond the radiation center height above ground level from the base of the SDARS repeater antenna.

<u>The Restrictions Proposed By SDARS For WCS Ground Level Signal Strength Would Effectively Preclude WCS From Being Used For Cellularized Services</u>. WCS licensees have been permitted to operate their base stations at 2000 watts peak EIRP and their mobile stations at 20 watts peak EIRP since WCS and SDARS were created in tandem in 1997 and SDARS interests never objected to those levels as they were being adopted. Yet, XM and Sirius now complain that the inexpensive receivers they have marketed to the public are vulnerable to overload interference from WCS facilities that meet the current rules. So, XM and Sirius ask the Commission to bail them out of another problem of their own making by imposing unprecedented new restrictions on the power at which WCS can operate.

XM and Sirius not only continue to call for a 100 dBµV/m ground level field strength limit for A and B Block WCS licensees, but now propose to drop the ground level field strength limit for C and D Block WCS licensees to 90 dBµV/m – *just one tenth of that permitted for the A and B Block WCS licensees and one-hundredth that permitted for SDARS repeaters*. Neither of these proposals should be adopted. Comparison between a system modeled under the current rules and one modified to meet the SDARS proposed rules shows that if a WCS licensee were required to comport with a 100 dBµV/m ground level field strength limit shows that, more than twice the number of base stations would be required than are required under the current rules. And, as problematic as a 100 dBµV/m ground level field strength limit would be for A and B Block licensees, the 90 dBµV/m limit that XM and Sirius are now proposing for the C and D Block WCS licensees would be devastating – more than six times the number of base stations would be required than under the current rules. Either approach would make it impossible for the resulting system to be a commercial success in the marketplace.

Similar results would obtain were the Commission to adopt SDARS's proposal to reduce the power of mobile devices from 20 watts peak EIRP to 10 milliwatts if operating on the A and B Blocks, and to 1 milliwatt if operating on the C and D Blocks. Modeling shows that for a system that utilizes just the A and B Block WCS channels, adoption of the latest SDARS proposal would require the installation of more than four times the number of base stations in a system that was designed, not to use the maximum permissible 20 watt WCS mobile power level, but to limit mobile power levels to just 300 milliwatts. And, not surprisingly, the problem becomes even worse if that system utilizes the C or D Block – *almost thirteen times the number*

of base stations will be required. In other words, were the Commission to adopt the 1 milliwatt/10 milliwatt limits on WCS mobile and portable transmitters that SDARS proposes, the increased network infrastructure costs will effectively preclude the provision of two-way wireless broadband services over the WCS spectrum.

Adoption Of A 2000 Watt Average EIRP Limit For WCS Will Not Result In Increased Interference. Allowing WCS licensees to operate at 2000 watts average EIRP will not subject neighboring services to any meaningful risk of interference that is not present today. At present, the Commission does not regulate the waveform employed by WCS licensees, and they are free to utilize waveforms with a constant envelope. As a practical matter, a WCS licensee is free to operate at 2000 watts average EIRP, because with constant envelope waveforms the peak power and average power levels are equal. By allowing WCS licensees to transmit at up to 2000 watts average EIRP, the Commission will eliminate the bias in the current rule against using wideband technologies that employ non-constant envelopes. Doing so, the Commission has recognized elsewhere, does not result in a material increase in the risk of interference.

The Repeaters SDARS Has Constructed Pursuant To STA Should Be Brought Into Compliance With The New Rules. Continued operation of the existing SDARS repeaters, without retention of the existing obligation for SDARS to cure any interference caused by those repeaters, will cause undue harm to WCS licensees and their subscribers. The number of new repeaters that would be required appears to be overstated by the SDARS licensees and, in any event, XM and Sirius assumed the risk of new construction and disruption to existing operations when they chose to bull ahead with deploying high-power repeaters pursuant to STAs while the Commission was considering the maximum power for gap-fillers.

The Commission Should Reject The Proposal Advanced By AFTRCC To Impose Tighter OOBE Limits On WCS. The WCS Coalition has not proposed any change in Section 27.53(a)(3) of the Commission's Rules, which since WCS was established in 1997 has required WCS licensees engaged in fixed or mobile operations to attenuate their OOBE into the 2360-2370 MHz band by at least 43 + 10 log (p), and to attenuate their OOBE above 2370 MHz by at least 70 + 10 log (p). AFTRCC participated in the proceeding where those limits were adopted, and did not seek reconsideration or otherwise suggest that they would be problematic. Now, however, AFTRCC urges the Commission to impose a 110 + 10 log (p) attenuation requirement on all WCS OOBE above 2360 MHz. The Commission should reject that request, which if adopted would have the same preclusive impact on neighboring WCS operations as the current 110 + 10 log (p) mask into the 2320-2345 MHz band has. AFTRCC and its constituents have been on notice for more than a decade that they faced OOBE from WCS, and the burden should be on them to modify their systems to protect against OOBE interference.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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 No. 8610

REPLY COMMENTS OF THE WCS COALITION

The WCS Coalition, by its attorneys and pursuant to Section 1.415 of the Commission's Rules,[1] hereby submits its reply to the comments filed in response to the *Further Notice of Proposed Rulemaking* in IB Docket No. 95-91 and the *Notice of Proposed Rulemaking* in WT Docket No. 07-293 (collectively, the "*Notice*").[2]

I. INTRODUCTION.

In responding to the *Notice*, the two satellite Digital Audio Radio Service ("SDARS") licensees do what they have consistently done in this proceeding – engage in "recrimination, obfuscation, misdirection, and overreaching to advance a strategy for subjugating the WCS band to SDARS in perpetuity."[3] Sirius Satellite Radio Inc.

---

[1] 47 C.F.R. § 1.415.

[2] *Amendment of Part 27 of the Commission's Rules to Govern the Operation of Wireless Communications Services in the 2.3 GHz Band; 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, FCC 07-215 (rel. Dec. 18, 2007) ["*Notice*"].

[3] Reply Comments of WCS Coalition, IB Docket No. 95-91, at i (filed Dec. 21, 2001) ["2001 WCS Coalition Reply"].

("Sirius") and XM Radio Inc. ("XM") have abandoned even the masquerade of compromise that had cloaked their recent filings, and instead now advance a regulatory scheme designed to crush any prospect for Wireless Communications Service ("WCS") to satisfy the growing public demand for wireless broadband services.[4] While SDARS had once proclaimed that coexistence of WCS and SDARS terrestrial repeaters is best promoted by rules that impose "equal and mutual obligations upon both services,"[5] XM and Sirius now abandon a host of prior positions and advocate vastly different rules for

---

[4] The suggestion by Sirius that the 30 MHz of spectrum allocated to WCS at 2.3 GHz is insufficient to support any mobile services is totally devoid of merit. *See* Comments of Sirius Satellite Radio Inc., WT Docket No. 07-293 at 15 n.46 (filed Feb. 14, 2008) ["Sirius Comments"]. Sirius' claim is based solely on its mischaracterization of a WiMAX Forum analysis of the spectrum necessary to provide a particular suite of applications utilizing the IEEE 802.16e-2005 standard under a very specific deployment scenario. Specifically, the study assumed a European deployment in an urban area with very specific assumptions made for the nature of the services provided, the percentage of residents that will subscribe to the service, the services that those subscribers will demand, the uplink/downlink ratio needed to accommodate the projected services demanded by subscribers, etc. *See, e.g.*, WiMAX Forum, "A Review of Spectrum Requirements for Mobile WiMAX Equipment to Support Wireless Personal Broadband Services," at 34 (Sept. 2007). However, the report cited by Sirius also recognizes that as particular assumptions change, the spectrum requirement diminishes. *See, e.g., id.* (noting that the study assumed a highly asymmetric traffic pattern with heavy use for distribution of high definition video to subscribers, and that more business-oriented service providers would require less spectrum.).

In fact, in 41 of the 52 Major Economic Areas ("MEA") used for licensing the A and B Block WCS spectrum, one licensee has at least 20 MHz of WCS spectrum. And, in only 3 of the MEAs in the continental United States does no licensee have more than 10 MHz. As the Commission is well aware, this is sufficient for the provision of mobile services. For example, in the Commission's ongoing 700 MHz auction, only the C Block has an allocated bandwidth greater than 20 MHz (and it is only marginally larger at 22 MHz) while the remaining blocks have smaller allocations. *See Service Rules for the 698-746, 747-762, and 777-792 MHz Bands*, Second Report and Order, 22 FCC Rcd 15289, 15203 (2007). Meanwhile, in the Commission's AWS-1 proceeding, only three of six license blocks were 20 MHz in total bandwidth. *See Auction of Advanced Wireless Services Licenses Scheduled for June 29, 2006*, Public Notice, 21 FCC Rcd 794, 796 (2006).

[5] Petition of Sirius Satellite Radio Inc. for Rulemaking, and Comments, IB Docket No. 95-91, at 2 (filed Oct. 17, 2006) ["Sirius Petition"]. *See also* Letter from Bruce D. Jacobs, Counsel for XM Radio Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, IB Docket No. 95-91 at 4 (filed Jan. 5, 2007) ["XM Response to Sirius Petition"].

the two services – differences that exacerbate the fundamental flaws in Sirius' 2006 petition for rulemaking and go even further toward disenfranchising WCS licensees.[6]

Reading the filings by XM and Sirius, one would think that the Commission had created WCS as a secondary service, consigned to accept whatever interference SDARS throws its way while obligated to make whatever sacrifices are necessary to assure that no SDARS subscriber ever suffers even unperceivable interference.[7] Of course, the facts simply do not support SDARS's revisionist history.

---

[6] Perhaps this is best illustrated by their change in position on their proposed rules for governing the maximum field strength of repeaters and WCS base stations. While initially Sirius and XM had proposed that the rules provide for the same maximum field strength (100 dBµV/m) for all licensees in the two services, they now would have the Commission allow SDARS terrestrial repeaters to operate at approximately *twenty times* the power of some WCS licensees. Sirius Comments at 30; Comments of XM Radio Inc., WT Docket No. 07-293 at 21 (filed Feb. 14, 2008) ["XM Comments"]. That adoption of the SDARS approach would have dramatic adverse consequences is discussed in detail *infra* at Sections II.B and II.C.

Similarly, while SDARS had once proclaimed a willingness "to accept a level of interference that could significantly compromise" its service (Sirius Petition at 5), it now advocates rules designed to provide absolute protection against interference without regard to the impact those rules have on the ability of WCS licensees to bring much-needed wireless broadband services to the public. Section II.D *infra* demonstrates that adoption of the limits on WCS operations proposed by SDARS would effectively preclude two-way wireless broadband services in the WCS band.

While XM and Sirius had previously advocated that the Commission modify Part 27 of its rules to permit WCS licensees to operate at 2000 watts average equivalent isotropically radiated power ("EIRP"), they now reverse field and seek to have WCS constrained to a 2000 watt peak EIRP limit that imposes an inappropriate bias against non-constant envelope technologies. *See infra* at Section II.E.

Moreover, it now appears that XM is retreating from its earlier endorsement of Sirius' recognition that modifications to Part 25 and to Part 27 necessary to facilitate the coexistence of the two services "be concluded simultaneously." *Compare* Sirius Petition at 2 *with* XM Comments at 2. This is hardly surprising – little would benefit XM more than to secure the benefit of final repeater rules, and then drag the remainder of this proceeding on for years as the window of opportunity for WCS to emerge as a viable home for wireless broadband in the United States closes.

Of course, not all of the reversals by SDARS are for the worse. For example, the WCS Coalition is certainly pleased that XM now agrees that no rules to govern collocation of WCS and SDARS facilities are needed. *See* XM Comments at 38-39; Comments of WCS Coalition, WT Docket No. 07-293, at 35-38 (filed Feb. 14, 2008) ["WCS Coalition Comments"].

[7] *See, e.g.*, Sirius Comments at 12; XM Comments at 7-8. XM and Sirius both go to great trouble to explain how they have utilized frequency diversity to meet their service objectives, and appear

While XM and Sirius content themselves with quoting Commission statements out of context, they conveniently ignore that the Commission spoke with crystalline clarity on the relationship between SDARS and WCS in the initial *Report and Order* in General Docket No. 96-228 that established WCS. There, the Commission left no ambiguity that the desire for a high quality SDARS must "be balanced with the need to provide reasonable operating parameters for adjacent services" and thus its objective in governing WCS must be "to limit the potential for interference to a reasonable level -- not to provide a pure, interference-free environment."[8] Not surprisingly, then, the *Notice* makes clear that the Commission's objective in this proceeding is to craft rules "that would allow SDARS terrestrial repeaters and WCS operation to coexist in adjacent bands."[9] Yet, the proposals now being advanced by SDARS ignore the Commission's stated objectives, to the detriment of a public that is demanding ever-expanding access to wireless broadband services.[10]

---

to be suggesting that the rules should be designed to assure that no subscriber suffers interference to even one of the triplicate programming streams. *See, e.g.*, Sirius Comments at 20; XM Comments at 12-16. As the WCS Coalition explained in its initial comments, however, that approach overly-protects the subscriber, since the subscriber only requires one programming stream to enjoy access to The Howard Stern Show or whatever other SDARS programming he/she is enjoying. As the Commission considers the probability for interference to a subscriber, logic dictates that it focus on the probability that the subscriber will have access to at least one program stream without interference, rather than on the receipt of some level of undesired signal that, as a practical matter, has no impact whatsoever on the ability of a SDARS subscriber to listen to his or her desired programming.

[8] *Amendment of the Commission's Rules to Establish Part 27, the Wireless Communications Service ("WCS")*, Memorandum Opinion and Order, 12 FCC Rcd 3977, 3991 (1997) ["*WCS Reconsideration Order*"] (emphasis added).

[9] *Notice*, App. A at 1. *See also id.* at ¶ 3.

[10] Sirius' assertion that "no WCS licensee has sought to provide mobile service at 2.3 GHz even though the Commission has adopted a mobile standard for a certain type of portable system" is disingenuous. Sirius Comments at 15. Admittedly, the Personal Access Communications System ("PACS"), for which the Commission adopted special out-of-band emissions ("OOBE") rules in 1997, has not been implemented in the United States, no doubt at least in part because the severe restrictions imposed by the Commission would have effectively precluded consumer acceptance.

Are XM and Sirius hoping to eliminate even the remotest possibility that Internet radio services accessible by WCS will in the future pose a competitive threat to their subscription services?[11] Are they attempting to diminish the utility of WCS spectrum to the point that they can purchase it (as XM has already tried to do) at bargain-basement prices?[12] Or do they recognize that their receivers have been poorly designed to avoid overload interference from WCS mobile and portable devices that are permitted even under the current rules, and hope to so burden WCS licensees that such devices will never

---

A lack of interest in PACS, however, does not translate into a lack of interest in mobile services. As the record makes clear, WCS licensees *are* seeking to provide mobile services at 2.3 GHz, but are effectively prevented from doing so because the current Part 27 rules effectively block any possible offering of mobile broadband services that are demanded by consumers. *See, e.g.*, WCS Coalition Comments at 2. As the WiMAX Forum confirmed, "[u]nder the current rules, WCS licensees face unreasonably restrictive out-of-band emission (OOBE) limits that cripple their ability to obtain equipment and deploy commercially viable services in the band." Comments of WiMAX Forum, WT Docket No. 07-293 at 3 (filed Feb. 14, 2008) ["WiMAX Forum Comments"]. *See also id.* at 5 ("the current OOBE limits on WCS licensees are overly restrictive."). Motorola agrees with that view, advising the Commission that "[it] is critical that the current out-of-band emission limits on WCS stations be relaxed in order to make the service feasible." Comments of Motorola, Inc., WT Docket No. 07-293 at 9 (filed Feb. 14, 2008) ["Motorola Comments"].

[11] It is worth noting that in attempting to justify their merger, XM and Sirius would have the Commission believe that the availability of WCS should be considered as protection against anti-competitive conduct by the merged companies. *See* Consolidated Application for Authority to Transfer Control on behalf of Sirius Satellite Radio Inc. and XM Satellite Radio Holdings Inc., MB Docket No. 07-57, at 46 (filed March 20, 2007). However, it is highly unlikely that WCS licensees will exercise their option under the Commission's rules to provide a satellite SDARS service, and no member of the WCS Coalition is currently contemplating use of its spectrum for the offering of an audio-centric service that would be comparable to the services XM and Sirius offer their subscribers.

[12] Of course, a future attempt by XM and/or Sirius to acquire WCS spectrum would not be the first by a SDARS licensee to control WCS frequencies. On July 13, 2005, XM and WCS Wireless, Inc. entered into an agreement pursuant to which control over WCS licenses held by WCS Wireless License Subsidiary, LLC would be transferred from WCS Wireless to XM. On July 15, 2005, an application for Commission consent to that transfer was filed, and the Commission subsequently solicited public comment. *See* "*Ex Parte* Status Of Application For FCC Consent To Transfer Control Of WCS Wireless License Subsidiary, LLC From WCS Wireless, Inc. To XM Satellite Radio Holdings, Inc.," *Public Notice*, DA 05-2272 (rel. Aug. 11, 2005). The application was opposed by numerous parties, including Sirius. *See, e.g.*, Petition to Deny of Sirius Satellite Radio Inc. and Request for Removal from Streamlined Processing, File No. 0002240823 (filed Aug. 3, 2005). The application was subsequently withdrawn, and the WCS spectrum at issue was transferred to NextWave Wireless Inc. ("NextWave").

see their way to market? The WCS Coalition and the Commission can only speculate as to the motives driving the two SDARS licensees in this proceeding. But one thing is clear – XM and Sirius are attempting to pull off the grand illusion that their own narrow self-interest equates to the larger public interest. In doing so, however, they make a mockery of the Commission's efforts to assure that the WCS spectrum is put to productive use in meeting the public's ever-growing appetite for wireless broadband.[13]

The WCS Coalition, by contrast, has been willing to accept significant operational and financial hardships to advance a solution that will allow all licensees in the band to coexist and offer commercially viable services.[14] Will our solution provide SDARS with an interference-free environment? No, it will not – under our proposed rules both WCS and SDARS will be subject to the possibility of interference under a limited range of circumstances that are unlikely to occur with great frequency. Presumably, this is exactly what the Commission envisioned when it announced its intent "to limit the potential for interference to a reasonable level – not to provide a pure, interference-free environment."[15] In short, the Commission can and should look through the SDARS licensees' strategy of recrimination, obfuscation, misdirection and overreaching, and adopt the WCS Coalition's rational, reasonable, and straightforward approach to achieving the Commission's stated objective here – promoting coexistence between the two services.

---

[13] *See Consolidated Request of the WCS Coalition For Limited Waiver of Construction Deadline for 132 WCS Licenses*, Order, 21 FCC Rcd 14134, 14141 (WTB 2006).

[14] *See* Letter from Paul J. Sinderbrand, Counsel to WCS Coalition, to Marlene H. Dortch, Secretary, Federal Communications Commission, IB Docket No. 95-91 (filed July 9, 2007) ["WCS Compromise Proposal"]; WCS Coalition Comments.

[15] *WCS Reconsideration Order*, 12 FCC Rcd at 3991 (emphasis added).

Finally, the Commission should similarly reject the efforts of the Aerospace and Flight Test Radio Coordinating Council ("AFTRCC") to scuttle the development of the WCS band by ratcheting up the current restriction on OOBE above 2360 MHz by 67 dB. For all its *sturm und drang*, AFTRCC ignores one rather simple fact – *the WCS Coalition did not propose any change whatsoever in the spectral mask that has protected AFTRCC's members from interference for more than a decade!* As such, AFTRCC can hardly be heard to complain that adoption of our proposals will harm its constituents.

II. DISCUSSION.

A. TEST RESULTS AND ANALYSIS SUPPORT LOOSENING THE WCS SPECTRAL MASK INTO THE 2320-2345 MHZ BAND FOR LOW POWER USER DEVICES EMPLOYING TRANSMIT POWER CONTROL.

While the parties to this proceeding disagree on much, there are two points on which there is no real disagreement. First, since WCS was established in 1997, the Table of Allocations has authorized WCS licensees to engage in fixed or mobile services.[16] And second, the current restrictions on OOBE by WCS into the 2320-2345 MHz SDARS band are so restrictive that they have the effect of precluding Americans from enjoying the benefit of the growing international trend towards mobile wireless broadband at 2.3 GHz.

This is not just the view of the WCS Coalition.[17] The WiMAX Forum confirms that "mobile broadband equipment based on the WiMAX standard has been developed for the 2.3 GHz band and is already in use in other countries,"[18] but that "if the current

---

[16] *See* 47 C.F.R. § 2.106; *Amendment of the Commission's Rules to Establish Part 27, the Wireless Communications Service ("WCS")*, Report and Order, 12 FCC Rcd 10785, 10787 (1997) ["*WCS Report and Order*"].

[17] *See* WCS Coalition Comments at 4-7.

[18] WiMAX Forum Comments at 5.

OOBE requirements remain in effect, this growing trend will not reach the United States."[19] Similarly, Motorola advises the Commission that:

> [f]rom a terrestrial standpoint, momentum is growing around the world for use of the 2300-2400 MHz band . . . for WiMAX and other broadband wireless access technologies. The WiMAX Forum has a system profile which includes the 2.3 GHz band and the WCS license blocks in the United States. In 2007, this frequency band was identified for use by International Mobile Telecommunication ("IMT") technologies, including WiMAX, on a globally harmonized basis in the international Radio Regulations. In addition, may countries around the world are proceeding with licensing of the 2.3 GHz band for broadband wireless access, and systems are being implemented. These developments underscore the benefits consumers and service providers in the United States could accrue from economies of scale for WCS equipment in the band, if technical requirements imposed are sufficiently similar to those applicable elsewhere in the world.[20]

Confirming the points made by the WCS Coalition, Motorola establishes that "[t]he costs of filtering for consumer premise equipment (fixed or mobile) to meet the current out-of-band emission levels leads to prohibitively expensive equipment. Further, the size of the required filtering exceeds the form factor for consumer premise equipment."[21] George Bednekoff, an experienced developer of 2.3 GHz broadband equipment, also confirmed that "[t]he current 110+10log(P) mobile station emissions limit effectively stops development of mobile products for the 2.3 GHz WCS band for the US market."[22]

---

[19] *Id.* at 6-7.

[20] Motorola Comments at 2-3 (footnotes omitted); WiMAX Forum Comments at 2 ("The 2.3 GHz band is an important frequency band for the deployment of WiMAX and commercial wireless broadband services globally.").

[21] Motorola Comments at 9.

[22] Comments of George Bednekoff, WT Docket No. 07-293, at 2 (filed Feb. 14, 2008). Mr. Bednekoff also recommended a specific rule to govern the procedure for measuring compliance with the WCS OOBE rules. *See id.* The difference between his proposal and that previously advanced by the WCS Coalition (*see* WCS Compromise Proposal at 9-10) is immaterial, and the WCS Coalition has no objection to use of Mr. Bednekoff's formulation.

Indeed, even XM and Sirius effectively concede that the current mask precludes the provision of mobile services in the band.[23]

As invariably happens whenever the issue of mobile operations in the WCS band is raised, the SDARS licensees trot out thread-bare citations to where the Commission cautioned WCS auction participants that the service would initially be subject to OOBE restrictions that could make provision of mobile services challenging.[24] What they ignore, however, is that at the same time the Commission also made clear that it was open to loosening those OOBE restrictions in the future should it be possible to do so without material adverse impact on SDARS subscribers.[25] As such, the issue before the Commission in this proceeding is not what services could or could not be provided in 1997 without out-of-band interference, but whether the Commission can in 2008 free the WCS band for its current highest and best uses without subjecting SDARS subscribers to unreasonable levels of out-of-band interference. Indeed, it is difficult to square the present positions of XM and Sirius with their assertion that, in evaluating their proposed merger, it would be improper for the Commission to:

> [i]gnore the market realities and all of the competitive and technological developments that exist today, and to consider only the evidence that existed ten years ago. That is untenable. "An agency is not required to 'establish rules of conduct to last forever,' but rather 'must be given ample latitude to adopt [its] rules and policies to the demands of changing circumstances.'"[26]

---

[23] *See* Sirius Comments at 13; XM Comments at 7-8.

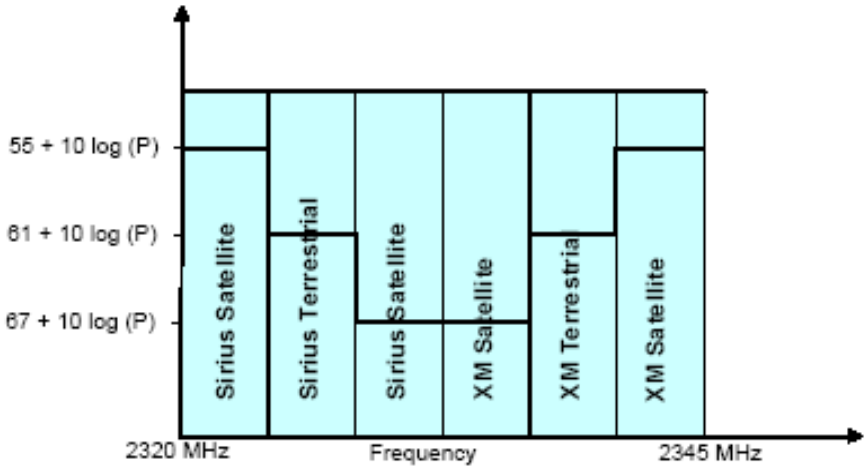
[24] *See id*.

[25] *See WCS Reconsideration Order*, 12 FCC Rcd at 3979, 3991.

[26] Consolidated Comments of Sirius Satellite Radio Inc. and XM Satellite Radio Holdings Inc., MB Docket No. 07-57, at 6 (filed Aug. 13, 2007), *citing Rust v. Sullivan*, 500 U.S. 173, 186-87 (1991) (*quoting Motor Vehicles Mfrs. Ass'n of United States, Inc. v. State Farm Mut. Automobile Ins. Co.*, 463 U.S. 29, 42 (1983).

That is exactly what the WCS Coalition is asking the Commission to do here – revisit its 1997 findings as promised, and determine whether, given changes in technology, it is still necessary to hamstring WCS licensees with highly-restrictive OOBE requirements.

The proposal advanced by the WCS Coalition has been carefully crafted to limit OOBE interference to SDARS receivers. Under our proposal, relief would only be available for user stations transmitting at less than 2 watts average transmitter output power, and for mobile stations transmitting at less than 2 watts average EIRP. And, it would only be available to those low-power devices that also incorporate transmitter power control mechanisms that reduce transmit power to a lower level that is sufficient to accomplish the desired communications. Moreover, the proposed mask is stepped – OOBE would be attenuated by an additional 12 dB into one of each licensee's satellite streams. This stepped mask can be illustrated as follows:



When the WCS Coalition first advanced this proposal, it provided the Commission with a detailed theoretical analysis, drawn primarily from information Sirius had already submitted to the Commission, demonstrating that adoption of the proposal

would not result in undue OOBE interference to SDARS subscribers.[27] More recently, however, OOBE interference testing performed by ATECS, LLC ("ATECS") under an experimental special temporary authorization granted to a member of the WCS Coalition confirms that Sirius is wrong in suggesting that the OOBE relief sought "would result in unacceptable mobile-into-mobile interference even when the victim and interfering devices are separated by significant distances."[28] Indeed, an analysis of the test results

---

[27] *See* WCS Compromise Proposal at 10-13.

[28] Sirius Comments at 20-21. *See also* XM Comments at 31-32. While XM and Sirius assert that WCS mobile devices must attenuate their OOBE into the SDARS band by 102.7 + 10 log (p) – a level that is no more acceptable than the present restriction – conducive to mobile operations tha the present limit, that claim is predicated, not on field testing, but on a theoretical analysis that is highly-flawed.

Rather than focusing on real world impairments, the SDARS licensees erroneously look merely to identify the OOBE that will cause a 1 dB rise in a noise floor associated with deep space antenna temperature measurements. *See* Sirius Comments at 21; XM Comments at 31-32.

As discussed in detail in Attachment A, the SDARS licensees assume a noise floor of -113 dBm in a 4 MHz bandwidth, which is 5 dB lower than the -108 dBm per 4 MHz that would be the noise level of a perfect 0 dB noise figure amplifier terminated with a room temperature 50 ohm resistance. A reasonable reference noise level to be used for OOBE impact from ground based devices is -105 dBm per 4 MHz. This is the noise level of a 3 dB noise figure receiver referenced to the input ports of the low noise amplifier connected to the receiving victim antenna for ground level noise with an antenna temperature of 290 K. While the antenna temperature measured for the satellite SDARS antenna will deviate from 290 K, often being much higher due to environmental noise and sometimes lower due to the antenna pattern attenuating ground based thermal noise, the OOBE in question is from a ground based source and thus a ground based thermal noise is the most appropriate reference level. Measurements made by members of the WCS Coalition found a significant difference between the technique SDARS used for measuring -113 dBm per 4 MHz and the use of a noise power marker. Furthermore, testing in the field has found that is most cases environmental noise raises the noise floor above the 290 K antenna temperature by 10 dB or more. Only in rural areas were levels of -106 dBm per 4 MHz measured.

While a noise floor approach may have merit in appropriate cases, here the Commission must focus on SDARS receiver muting – which is the true measure of whether a SDARS subscriber will lose access to its service. Indeed, XM recognizes that "[s]ervice availability is defined as the time that programming remains uninterrupted over a given drive distance for a mobile receiver." XM Comments at 4 n.4. Focusing on a rise in the noise floor when it does not necessarily result in muting will only serve to limit unnecessarily the ability of WCS licensees to meet the public demand for wireless broadband services.

Also, Attachment A establishes that the pathloss assumed by SDARS is flawed. Independent tests by ATECS and NextWave in three different locations (two in Virginia and one in California)

shows that at three meters separation,[29] WCS user stations that comport with the WCS Coalition's proposed OOBE mask and employ transmit power control are highly unlikely to cause OOBE interference to SDARS satellite reception.

Attachment B to these reply comments is a report prepared by ATECS of field testing it conducted in Northern Virginia in February and March, 2008 to examine the impact that WCS transmissions meeting our proposed mask will have on the reception of SDARS satellite signals. As is discussed in detail in that report, ATECS determined how close a compliant WCS transmitter can come to a SDARS reception antenna without muting the SDARS satellite signal. Testing was conducted using six different receivers, three from each company (two of which were purchased from retail outlets and the other was installed as OEM equipment on a rental vehicle). The testing was undertaken under "worst case" conditions – transmit power control was not used, there were no obstructions whatsoever between the WCS transmitter and the SDARS receiver, the WCS

---

have shown that the actual pathloss between mobile CPE at separations distances up to 33 meters is significantly higher than XM and Sirius claim. In fact, at the 3 meter distance, this testing shows that the actual pathloss is 61.4 dB based on the WCS Coalition's field-tested equation Pathloss = 50.9 + 21.8 Log (d) dB, rather than the 52.2 dB claimed by SDARS.

Sirius also makes the odd argument in opposition to the WCS Coalition's proposed mask into the 2320-2345 MHz band that "the WCS Coalition has not addressed how it could meet the relaxed standard in the satellite radio spectrum and still comply with limits on out-of-band emissions limits protecting aeronautical telemetry operations in the next adjacent band." Sirius Comments at 21. What Sirius misses is that the attenuation requirements on WCS OOBE into the telemetry band – a minimum attenuation of 43 + 10 log (p) into 2360-2370 MHz and 70 + 10 log (p) above 2370 MHz – are far less restrictive than the 110 + 10 log (p) mask at issue here. WCS equipment vendors have confirmed to members of the WCS Coalition that compliance with those limits is not problematic. Thus, as is emphasized in Section II.G below, the WCS Coalition has never proposed that it be relieved of its OOBE obligations relating to telemetry.

[29] XM and Sirius concede that a three meter separation standard is appropriate for considering the potential OOBE impact on SDARS receivers from WCS. *See* Sirius Comments at 32; XM Comments at 30. While the WCS Coalition believes that it is highly unlikely for WCS and SDARS mobile devices to be utilized in such close proximity, for purposes of these reply comments it has evaluated the potential for OOBE interference beyond a three meter separation distance.

antenna was aimed directly at the SDARS receive antenna, there was no mobility of either device and it was assumed that the WCS device was always being used to transmit and the SDARS device was always being used to listen.

Despite the exclusion of these factors, those tests demonstrate that only in the rarest cases will SDARS receivers be vulnerable to OOBE interference from low-power WCS devices that operate within three meters of the SDARS antenna when the benefits of transmit power control are considered. Indeed, when the tests were conducted using a 6% duty cycle for the WCS transmitter (which is the duty cycle associated with a WiMAX voice over IP ("VoIP") call, *there was no muting of any SDARS receiver beyond the designated three meters separation objective*. In fact, even when the duty cycle was increased to 43%, which assumes the highly unlikely scenario that a given WiMAX user will transmit during every uplink time slot assigned its base station segment (in other words, that it is the only user transmitting within the segment), the two Sirius non-OEM devices demonstrated immunity to OOBE interference.

As the WCS Coalition has emphasized since it first filed its proposal, only transmitters that utilize transmit power control should be entitled to employ the more flexible stepped spectral mask that is before the Commission.[30] In our comments in response to the *Notice*, we provided the Commission with a detailed discussion of the benefits that will be realized by the use of transmit power control in WCS transmitters.[31] Attachment C to these reply comments is a white paper prepared by NextWave that applies this learning to the results of the ATECS testing. The bottom line of that white paper is telling. When one factors in the benefits of transmit power control, the ATECS

[30] *See* WCS Compromise Proposal at 9; WCS Coalition Comments at 10.

[31] *See* WCS Coalition Comments, Attachment B.

testing shows that in eleven of the twelve tested scenarios, there will be no potential for OOBE interference at all, and that in the remaining case the potential for interference is negligible (and becomes non-existent with a 3.3 meter separation).[32]

In other words, the results of the testing that the WCS Coalition is now putting before the Commission confirms what the WCS Coalition has been saying all along -- that adoption of the WCS Coalition's proposal for spectral mask relief does not pose an undue threat of OOBE interference to SDARS receivers. The WCS Coalition is aware that XM and Sirius have proposed that the Commission mandate some sort of joint testing program between the WCS and SDARS communities to address the open technical issues in this proceeding.[33] Quite frankly, the WCS Coalition perceives this as just more grandstanding by the SDARS licensees and unnecessary given the test data that we are providing the Commission today. Nonetheless, if the Commission believes that joint testing would be helpful, the WCS Coalition is prepared to participate in a joint testing program to respond to any concerns the Commission may have regarding the vulnerability of SDARS receivers to OOBE interference or the ability of WCS to provide mobile broadband services under the rules being proposed by SDARS. To avoid delay, however, the WCS Coalition strongly urges that the Office of Engineering and

---

[32] *See* Attachment B at 5. The one exception involved an XM radio installed by the manufacturer of a rental vehicle, but even here the failure only occurs when the receive antenna is within 3.3 meters and the WCS transmitter is operating with a 43% duty cycle. Of course, as noted above, a WCS subscriber unit is unlikely to have a 43% duty cycle, and with a more realistic duty cycle, it is likely that the OOBE interference beyond three meters would be eliminated. And, in a real world deployment, in the isolated cases when an OEM radio is within 3.3 meters of a transmitting WCS user device but more than three meters away, it is likely that there will be additional attenuation between the two devices.

[33] *See* Letter from Patrick L. Donnelly, Executive Vice President, Regulatory Counsel and Secretary of Sirius Satellite Radio Inc. and James S. Blitz, Vice President, Regulatory Counsel of XM Radio Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, IB Docket No. 95-91 (filed Feb. 28, 2008).

Technology ("OET") staff be directly involved in the development of the testing program to assure that SDARS does not burden the process with testing that is unnecessary for resolution of the issues raised in the *Notice*, and that the conduct of that program be directly supervised by OET staff to assure that the testing is conducted in a fair and impartial manner.

B. THE SUBSTANTIALLY INCREASED SDARS GROUND LEVEL SIGNAL STRENGTH LIMIT THAT XM AND SIRIUS NOW PROPOSE WOULD EFFECTIVELY PRECLUDE TWO-WAY USAGE OF THE WCS BAND.

Affording low power WCS user devices relief from an overly-restrictive mask will prove to be a waste of Commission resources if, at the same time, the Commission imposes new restrictions on WCS that effectively preclude the very services that the loosened mask is designed to promote. Yet, perhaps recognizing that the facts no longer support retention of current spectral mask, that is exactly what XM and Sirius are advocating.

For example, the *Notice* solicited comment on Sirius' proposal to permit SDARS repeaters to operate without any limits whatsoever on their EIRP levels, so long as the resulting transmissions comport with a field strength limit of approximately 100 dBµV/m measured at a height of two 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 repeater antenna, except within an exclusion area at the base of the repeater.[34] While XM and Sirius had frequently pressed for adoption of Sirius' proposal,[35] in response to the

---

[34] *See Notice* at ¶¶ 15-16.

[35] *See* XM Response to Sirius Petition; Letter from Robert L. Pettit, counsel to Sirius Satellite Radio Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, IB Docket No. 95-91 (filed Dec. 3, 2007); Letter from Robert L. Pettit, counsel to Sirius Satellite Radio Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, IB Docket No. 95-91 (filed Dec. 5, 2007); Letter from Patrick L. Donnelly, Executive Vice President, Regulatory

Notice both have now recanted and instead seek authority to operate repeaters subject only to a field strength limit of 110 dBµV/m measured at ground level.[36] As troubling to the WCS community as the initial Sirius proposal was, this latest iteration magnifies the harm exponentially, *as it would permit SDARS to transmit at ten times the power level they had previously proposed*.[37]

Counsel and Secretary of Sirius Satellite Radio Inc. and James S. Blitz, Vice President, Regulatory Counsel of XM Radio Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, IB Docket No. 95-91 (filed Sept. 19, 2007).

[36] *See* Sirius Comments at 30; XM Comments at 21. In its recent filings, Sirius consistently refers to the proposed limit on repeaters as a "ground level" metric, and never specifies that measurements should be taken at two meters above ground level. *See* Sirius Comments at 25, 29, 30, Ex. A at 9-10. XM's comments are similar, although it does once reference a two meter measurement height for SDARS repeater signals. *Compare* XM Comments at 2, 18, 21, Ex. A at 11-12 *with* XM Comments at 20. By contrast, both specifically propose that WCS be subject to a restriction measured two meters above ground level. *See* Sirius Comments, Ex. A at 10, 13; XM Comments, Ex. A at 12, 15. Since both WCS mobile user stations and SDARS receivers are likely to be used at approximately two meters above ground level, not at ground level, there would be no reason to distinguish between the measurement points for the two. The Commission should note, however, that were WCS to be forced into a fixed wireless mode, as XM and Sirius seem to be suggesting, WCS user receivers are likely to be mounted higher than two meters above ground level in many cases, and this issue would have to be revisited to assure that they are appropriately protected because, as discussed *infra*, receive antennas mounted higher above ground are more vulnerable to interference. Indeed, none of this addresses the more fundamental flaw in the SDARS approach – *whether fixed or mobile service is offered, WCS base stations often are mounted 30 meters or more above ground level.*

Nonetheless, for simplicity's sake, throughout these reply comments the WCS Coalition will utilize the phrase "ground level signal strength" to refer to emission levels measured two 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 antenna, unless the context dictates otherwise.

[37] Paragraph 16, n.47 of the *Notice* also sought comment on the proposal by Sirius that "[w]ithin the area, as measured from the base of the repeater antenna, between (1) the radiation center height above ground level and (2) 5000 meters, each satellite DARS licensee may designate and identify up to 20,000 square meters, with no contiguous area greater than 8,000 square meters, where such repeater shall not exceed an average power level of -32 dBm (112 dBµV/m) measured 2 meters above ground level." *See Sirius Petition*, Appendix A, page A1. Neither XM nor Sirius has commented on this proposal, and the WCS Coalition can only speculate as to whether they continue to seek such an exception to their proposed field signal strength limit. Suffice it to say that adoption of the proposed rule would not obviate the flaws we point out in these reply comments on imposing a field strength limit on WCS discussed, but rather would increase the risk of the overload interference to which WCS licensees would be subjected by allowing even greater SDARS repeater ground level emissions than the unacceptable levels XM and Sirius do

Before turning to the implications of SDARS's revised proposal for WCS, the Commission should view with a jaundiced eye the explanation offered for waiting until the eleventh hour to propose a tenfold increase in permissible SDARS repeater power. Sirius would have the Commission believe that this dramatic change in position is occurring this late in the process because only now "has [Sirius] determined that its previously proposed 100 dBµV/m ground-emission limits is too restrictive for satellite radio terrestrial repeaters."[38] Given that Sirius has participated in the debate over repeater power issues for over a decade, and has been operating terrestrial repeaters for more than seven years, this explanation strains credulity.

Indeed, it is telling that neither Sirius nor XM provides any technical support whatsoever for the proposition that they cannot fill in gaps in satellite service unless SDARS repeaters are free to produce a ground level field strength of 110 dBµV/m. That is hardly surprising. XM has conceded that it designs for a repeater serving level of -88 dBm (which translates to approximately 58 dBµV/m),[39] and there is nothing on the record to suggest that it cannot meet that objective without generating a ground level signal strength as high as 110 dBµV/m. A SDARS terrestrial repeater field strength of that magnitude is both unnecessary and, as discussed in the following sections, tantamount to a death sentence for WCS wireless broadband services. The true objective of SDARS's proposed field strength increase cannot be camouflaged; it can only be

---

advocate. Thus, if the Commission does adopt a SDARS ground level signal strength limit, that limit should be measured two meters above ground level.

[38] Sirius Comments at 30.

[39] *See* XM Comments, Ex. B at 2.

explained as a ploy to free XM and Sirius to create so much interference that no wireless broadband service in the band could ever be viable.

1. XM AND SIRIUS AGAIN FAIL TO ADDRESS THE INTERFERENCE WCS BASE STATIONS WOULD SUFFER FROM SDARS REPEATERS.

The fundamental flaw in Sirius' original proposal to limit SDARS ground level field strengths to 100 dBµV/m was identified by the WCS Coalition in its response to the Sirius petition for rulemaking, and has yet to be forthrightly addressed by XM or Sirius. As the WCS Coalition established in its July 9, 2007 *ex parte* response to Sirius' petition:

> Sirius' proposal that average signal strength measurements for both services be taken two meters above ground level is unfairly skewed to favor its particular service (where receivers are generally located close to ground level). From the perspective of WCS licensees, however, DARS repeaters pose a massive threat to base stations, which will typically be located 20-70 meters above ground level.[40]

The WCS Coalition reiterated that point in response to the *Notice*, explaining to the Commission that:

> When measuring signal levels 2 meters above ground level, attenuation from a variety of natural and manmade clutter will come into play, allowing greater powers at the transmitter than might otherwise be permitted without that attenuation. However, WCS base station receivers will be installed far above this clutter to provide adequate coverage and maximize their ability to receive relatively weak signals from subscriber equipment. Thus, WCS base stations will suffer overload interference from SDARS terrestrial repeater signals that are sufficiently attenuated by clutter two meters above ground level that they meet the proposed limit.[41]

Yet, despite now proposing a rule that would permit operations at ten times the power they previously advocated, neither XM nor Sirius provide the Commission with any analysis of the potential for overload interference to WCS base stations. In fact, the almost identical technical analyses XM and Sirius submit to justify the proposed 110

---

[40] WCS Compromise Proposal at 6.

[41] WCS Coalition Comments at 32-33.

dBµV/m field strength limit for SDARS completely fail to even mention the potential for interference from terrestrial SDARS repeaters to WCS base stations, much less demonstrate non-interference.[42] Rather, they obscure the true threat of their proposal by limiting their analysis to the potential for interference to WCS user stations, and, as discussed in Section II.B.2 below, incorrectly conclude that over-powered SDARS terrestrial repeaters will not interfere with WCS user stations.[43]

---

[42] *See* Sirius Comments, Ex. A at 10; XM Comments, Ex. A at 12. Given this record, it is disingenuous for XM to suggest that ground level measurements are appropriate because "that is where the majority of receivers will be deployed." XM Comments at 18. While there will be more WCS user stations than WCS base stations (just as there are in any similar service), that hardly justifies the development of a regulatory scheme that only protects user stations. The fact is that if SDARS interferes with a WCS base station, then service to all of the users served by that base station also will be adversely impacted, even if the user receivers themselves are protected from direct interference from the SDARS repeater because they are farther down in the clutter. Both WCS base stations and user stations require reasonable protection against interference from SDARS repeaters.

[43] While Sirius and XM suggest that mobile wireless broadband networks pose a greater threat of overload interference than fixed wireless broadband deployments (*see* Sirius Comments at 15-17; XM Comments at 28), their embrace of WCS for fixed wireless broadband is predicated on a fundamentally incorrect assumption regarding the manner in which fixed service base stations would be deployed. Of course, to date there have been relatively few deployments of fixed wireless broadband in the 2.3 GHz band, and those systems that are currently operating are largely restricted to serving areas where cable modem and DSL service is limited. *See* Hamblen, "AT&T lights up WiMax in Juneau," Computerworld (Aug. 6, 2007), available at http://www.computerworld.com/action/article.do?command=viewArticleBasic&taxonomyName=wireless_trends_and_technologies&articleId=9029199&taxonomyId=78 (last viewed March 11, 2008) ("AT&T Inc.'s subsidiary AT&T Alascom today announced wireless WiMax-based broadband Internet service starting at $19.95 a month for Juneau, Alaska, residents. The launch is the first in a statewide plan to expand the reach of broadband through WiMax because conventional DSL and cable technologies have not reached some residents and small businesses in remote and difficult-to-reach areas, AT&T said in a statement."). However, were fixed wireless broadband to find greater success in the marketplace, operators would be required to heavily cellularize their networks to maximize frequency reuse and meet the ever-increasing demand of fixed service users for high-bandwidth applications. *Thus, Sirius and XM are dead wrong – fixed wireless systems are likely to have a similar number of cells as mobile systems, at similar heights above ground, and with similar use of downtilt*.

The potential for harm to WCS base stations from SDARS repeaters operating in excess of 2000 watts average EIRP is a matter of record before the Commission.[44] For example, Attachment F to the WCS Coalition's initial comments illustrated the problem by identifying areas in New York City, NY and Washington, DC where the WCS C and D block licensees will find their ability to deploy base stations severely constrained by the presence of existing high-powered SDARS terrestrial repeaters, many of which operate in excess of 2000 watts average EIRP.[45]

---

[44] Both Sirius and XM cite to a test report that accompanied a December 14, 2001 filing by XM for the proposition that "SDARS repeaters and WCS fixed wireless systems can coexist under the existing rules." *See* Sirius Comments, Ex. A at 9; XM Comments, Ex. A at 11. Of course, since there are no rules to govern SDARS repeaters, this statement is nonsensical at best. Indeed, XM's 2001 filing cannot even be read to show that WCS and SDARS can coexist under the current SDARS terrestrial configurations, as the WCS community established in response to that filing. *See, e.g.*, 2001 WCS Coalition Reply; Reply Comments of BeamReach Networks, Inc., IB Docket No. 95-91 (filed Dec. 21, 2001) ["BeamReach Comments"]; Letter from Karen B. Posner, BellSouth Corporation, to William F. Caton, Acting Secretary, Federal Communications Commission, IB Docket No. 95-91 (dated March 26, 2002) ["BellSouth Letter"]. The report that accompanied XM's filing reflected a single specific scenario where a particular WCS base station and a particular SDARS repeater were in close proximity. But as the report itself acknowledges, "the ATTWS Base station is almost directly behind the SDARS Repeater SDARS transmissions antenna" and, as can be seen from the report, the WCS base station was protected by being in the back lobe of the XM repeater pattern. What was not examined in XM's report, but what is relevant here, is how WCS equipment will perform when more directly within the front lobe of a SDARS repeater. *See, e.g.*, Letter from Randall Schwartz, BeamReach Networks, Inc., to William F. Caton, Acting Secretary, Federal Communications Commission, IB Docket No. 95-91, at 3 (dated March 22, 2002) ["BeamReach Letter"]. Moreover, the only channels licensed to the WCS provider at the time were the B Block, so more "guardband" was present between the XM repeater spectrum and the WCS base station than will necessarily be the case in other deployments. Other flaws in the XM study are also a matter of record before the Commission. *See id*.

[45] In conducting its analyses of the potential for interference from existing SDARS repeaters, the WCS Coalition presumed that SDARS was attenuating OOBE by 75+10 log (p) as proposed in the Sirius petition for rulemaking. XM and Sirius now claim that they are actually attenuating OOBE into the WCS band by 90 + 10 log (p). *See* Sirius Comments, Ex. A at 5; XM Comments, Ex. A at 7. Yet, for reasons they have not explained, they continue to propose that the final rules only require that SDARS repeaters attenuate OOBE into the WCS spectrum by 75+10 log (p). *See* Sirius Comments, Ex. A at 12; XM Comments, Ex. A at 14. Thus, since XM and Sirius seek to retain the flexibility to replace existing equipment with equipment that only meets this less restrictive level, it is appropriate for the WCS Coalition to continue utilizing just 75 + 10 log (p) attenuation in its analyses.

Subjecting SDARS repeaters to the 110 dBµV/m ground level field strength limit now being advocated by XM and Sirius would cause devastating overload interference. A WCS base station receiver operating on the C or the D Block is at risk of interference due to overload if it is exposed to a SDARS terrestrial signal with a field strength of approximately 104 dBµV/m measured at a base station antenna oriented towards the SDARS repeater.[46] Of course, the antennas for that WCS base station will be mounted far above the clutter that will attenuate signal levels measured two meters above ground level, and thus satisfying the 104 dBµV/m signal strength requirement at ground level is not tantamount to protecting the WCS base station. In urbanized areas, it can be expected that the undesired SDARS signal level at WCS base station antennas generally will be on the order of 30-50 dB stronger than the SDARS signal level at the same location measured just two meters above ground.

This is so because a signal will propagate differently from an elevated antenna location (*e.g.*, an SDARS repeater) towards a rooftop location (*e.g.*, a WCS base station) than it will propagate to the ground level at the same location.[47] The propagation mechanisms governing these relationships are illustrated in Figure 2 below. As shown in the figure, the propagation from the SDARS repeater to the WCS base station will

---

[46] *See* "Coexistence between IMT-2000 time division duplex and frequency duplex terrestrial radio interface technologies around 2600 MHz operating in adjacent bands and in the same geographic area.", Report ITU-R M.2030. *See also* WCS Coalition Comments at 48 n.106. In the case of the A and B Block, the acceptable SDARS signal strength is on the order of 113 dBµV/m, which reflects the additional frequency separation between those blocks and the SDARS terrestrial repeater spectrum. Of course, as the WCS Coalition noted in its initial comments in response to the *Notice*, because all of the engineering being provided in this docket presumes that XM and Sirius operate their repeaters using the spectrum currently used for such repeaters, the Commission should modify its rules to limit XM and Sirius to that specific spectrum for repeaters. *See* WCS Coalition Comments at 34-35.

[47] J. Walfisch, and H. L. Bertoni, "A Theoretical Model of UHF Propagation in Urban Environments," *IEEE Transactions on Antennas and Propagation*, vol. 36, no. 12, pp. 1788 – 1796 (Dec. 1988).

generally be unobstructed and impaired only by edge diffraction losses from the intermediary buildings along the propagation path. However, the propagation path from the SDARS repeater to the ground level will often be completely obstructed and the signal will suffer significant loss either from obstructions or from the diffraction and reflections losses as the signal propagations from roof level to the ground.

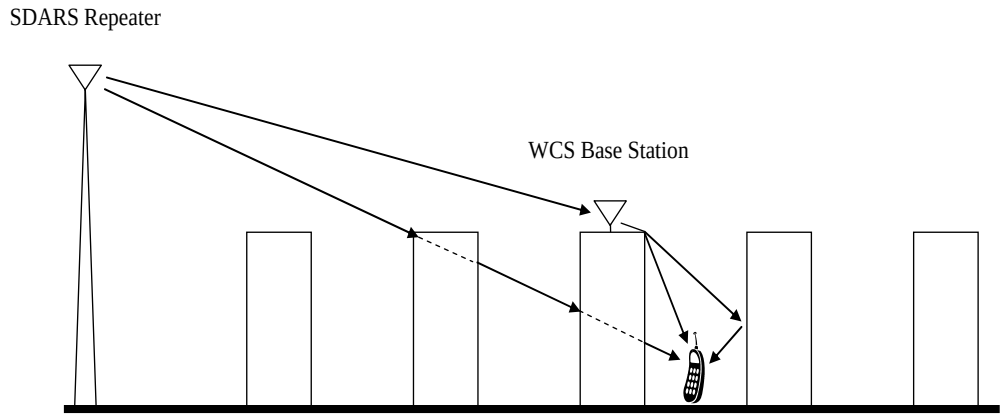


Figure 2. Signal propagation characteristics between SDARS repeater and WCS base station and mobile stations in urban areas

Published field measurements show that in urban areas, the signal loss at ground level can be 30-50 dB greater than on rooftops because of the additional obstructions.[48]

To illustrate the practical impact of this difference on WCS base stations, assume an urbanized situation where the difference in propagation loss between ground level and a typical building rooftop suitable for a WCS base station is 40 dB. If the field strength of the SDARS repeater were limited to 100 dBμV/m measured two meters above ground as XM and Sirius initially proposed, the field strength at the WCS base station antenna would be 140 dBμV/m, *a field strength 400 times stronger than what a WCS base station receiver can tolerate without likelihood of interference*. Were the Commission to adopt

[48] K. Low, "Comparisons of Urban Propagation Models with CW-Measurements," *IEEE Vehicular Technology Society 42nd VTS Conference*, vol. 2, pp. 936 – 942 (May 1992).

the latest XM and Sirius proposal to cap the ground level field strength of the SDARS repeater at 110 dBμV/m, the problem would be exacerbated and the field strength at the WCS base station antenna would be 150 dBμV/m – *4,000 times stronger that what a WCS base station receiver can tolerate without likelihood of interference*! Suffice it to say that XM and Sirius have not even attempted to demonstrate that a WCS base station can operate in the presence of such interfering signals.

2. SDARS'S PROPOSED TEN-FOLD INCREASE IN REPEATER POWER WOULD SUBJECT WCS USER EQUIPMENT TO UNREASONABLE LEVELS OF INTERFERENCE.

Not only have XM and Sirius tried to deflect attention from the well-documented interference threat that adoption of their new 110 dBμV/m ground level emission limit proposal would pose for WCS base stations, they compound the problem by claiming that their proposal for a tenfold increase in SDARS repeater power would have no adverse impact on WCS user stations.[49]

SDARS reasons, albeit without any detailed analysis, that the 10 dB increase in the permissible ground emissions level of SDARS repeaters would be benign to WCS

[49] *See* Sirius Comments, Ex. A at 10; XM Comments, Ex. A at 12. Illustrative of its strategy of misdirecting the Commission's attention, XM goes to great length to "prove" what is not disputed – that terrestrial repeaters serve an important role in filling gaps in satellite coverage. *See* XM Comments at 5-7. Of course, the WCS Coalition has never objected to the authorization of "gap fillers" that are narrowly crafted to fill coverage holes without causing unnecessary interference to WCS operations. The problem here, in a nutshell, is that XM would prefer to fill those gaps as cheaply as possible – through the use of fewer repeaters operating at higher power levels – without regard to the overload interference caused to WCS licensees. *See* WCS Coalition Comments at 41-44. No one questions XM's claim that it has no incentive to build repeaters that are unnecessary. *See* XM Comments at 14. What the Commission must note, however, is that SDARS has every incentive to minimize the cost of its repeater network, and unless the FCC imposes regulations to protect WCS, that will lead SDARS to deploy fewer repeaters with high power where it is less costly to do so. The current deployment is proof of the pudding – SDARS has repeater coverage in numerous areas where it is not necessary, simply because it was less expensive to blanket the area with a single repeater than to put in lower power, narrowly-focused gap-fillers.

receivers because "WCS receivers should tolerate an overload level of at least -35 dBm."[50] That presumption, which SDARS concedes is not based on the performance characteristics of actual WCS user equipment,[51] is simply not correct.[52] To the contrary, it substantially overestimates the immunity of a WCS user device to SDARS transmissions, which actually are likely to overload when subjected to SDARS signals on the order of -44 dBm or 100 dBμV/m.[53]

---

[50] Sirius Comments at 30. *See also* XM Comments, Ex. A at 9.

[51] *See* Sirius Comments, Ex. A at 10; XM Comments, Ex. A at 12. The decision by SDARS to base its assumptions regarding WCS performance on the performance of SDARS receivers was curious. SDARS assumes "a [WiMAX] receiver implementation similar to an SDARS receiver that provides 60 dB of protection." Sirius Comments, Ex. A at 7. XM asserts that a "satellite receiver must be more sensitive than a typical mobile terrestrial receiver" and that their receivers "are required to process a wide dynamic range of signals" would suggest that there is very little commonality among SDARS and WCS receivers. XM Comments, Ex. A at 8. The receiver power amplifier performance, automatic gain control loop functionality, front end filter, and receiver architecture ("super heterodyne" versus "zero IF") will together determine the immunity of a receiver to overload interference. Given the vast differences in the airlink technology between SDARS and WCS, there is no valid reason to assume that SDARS and WCS receiver implementations would perform in a similar fashion.

[52] One, but not the only, flaw in SDARS's analysis is their assumption that -95 dBm is the appropriate WCS receiver sensitivity to employ in the overload computation. XM and Sirius lift this sensitivity figure from a WiMAX link budget. However, by its very nature a link budget will employ the most robust (and interference tolerant) modulation and coding scheme supported in the system to define the limit of coverage. Because wireless broadband technologies, like WiMAX, employ adaptive modulation and coding schemes, the receiver sensitivity used in an overload computation should be based on the highest order scheme (64QAM code rate 3/4) not the lowest order (QPSK code rate 1/2, as assumed by SDARS here).

[53] SDARS's apparent reliance on data submitted by NextWave, a WCS Coalition member, in the Commission's ongoing proceeding regarding the future of the 2155-2175 MHz ("AWS-3") band is particularly misplaced. *See* XM Comments at 24 n.44. However, the situation there is not analogous to that present here. There, NextWave advocated a "lightly-licensed" approach for AWS-3 similar to that employed by the Commission for 3650-3700 MHz band – an approach that is tantamount to an unlicensed regulatory scheme. *See* Reply Comments of NextWave Wireless Inc., WT Docket No. 07-195, at 8-10 (filed Jan. 14, 2008). As is discussed in detail in the reply comments that NextWave is filing today in these proceedings, NextWave was seeking to facilitate access to the spectrum by multiple parties without expenditure of large capital resources and, in the process, provide economies of scale for the sort of specialized equipment that will be deployed in the "lightly licensed" bands. NextWave's reply comments demonstrate that SDARS errs in arguing that NextWave's filing in the AWS-3 proceeding is instruction on how the Commission should resolve the matters pending here.

This figure is based on initial testing of WiMAX prototype receivers developed by NextWave. That testing indicates that a WiMAX WCS mobile may be protected from an SDARS interferer up to a level of -44 dBm. This is clearly an aggressive figure that reflects use of "state of the art" technology, particularly when one considers that commercially available mobile receivers for other bands adhere to much lower specifications (for example -56 dBm for a UMTS handset).[54]

That SDARS's proposed ground level signal strengths would be problematic to state of the art WCS receivers should not be particularly surprising given filings that Sirius has previously submitted to the Commission. XM blithely suggests that WCS should be able to deploy user equipment that will be immune to interference from SDARS over-powered repeaters because "XM and Sirius sell inexpensive radios in the retail market that coexist with each other."[55] In other words, XM would have the Commission conclude that if XM and Sirius can avoid interference between their own terrestrial repeater operations, WCS should be able to do the same.[56] Leaving aside the fundamental differences between the two services that make it difficult to compare vulnerability,[57] XM's line of argument conveniently ignores an inconvenient truth -- before XM and Sirius agreed to merge, Sirius complained mightily to the Commission that "[s]ignal overload from XM SDARS terrestrial transmitters is currently the most

---

[54] European Telecommunications Standards Institute, Universal Mobile Telecommunications System; User Equipment (UE) Radio Transmission and Reception (FDD), 3GPP ETSI TS 25.101, Table 7.6 (Jan. 2008).

[55] XM Comments at 22.

[56] *See id*. at 21 ("if WCS receivers are designed to provide protection from the SDARS repeater signals equivalent to that which the current SDARS receivers provide from WCS interference, [its proposed 110 dBµV/m] ground-level emission limit is reasonable.").

[57] *See supra* note 51.

significant cause of service outages for Sirius' satellite delivery."[58] In other words, Sirius receivers experienced the very same sort of interference from terrestrial repeaters that WCS fears it will suffer. No matter how much XM and Sirius would like to blame WCS reception equipment for overload, the fact is that even with its state of the art equipment, WCS can no more avoid overload than SDARS can. That is why it is essential that the rules governing SDARS terrestrial repeaters be established from the beginning to reduce the prospects for overload to reasonable levels.

3. IF THE COMMISSION DOES IMPOSE A FIELD STRENGTH LIMIT TO GOVERN SDARS INTERFERENCE TO WCS, IT MUST ASSURE APPROPRIATE PROTECTION TO WCS.

Nothing filed by XM or Sirius changes the WCS Coalition's belief that limiting EIRP to 2000 watts average, rather than ground level field strength levels, is the most appropriate manner to govern WCS and SDARS operations. XM and Sirius are wrong in suggesting that a ground level signal strength limit "will be a very reliable predictor of harmful interference."[59] To the contrary, for the reasons discussed above and in other proceedings, ground level field strength, particularly standing alone without an EIRP component, is a very poor predictor of interference to WCS.[60] While certainly not a

---

[58] Letter from Carl R. Frank, Counsel to Sirius Satellite Radio Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, File No. 0002240823, DA 05-1662, WT Docket No. 05-256, WT Docket No. 03-264, IB Docket No. 95-91, Attachment, "White Paper: Interference to the SDARS Service from WCS Transmitters," at 16 (filed March 29, 2006). *See also id.* at 3 ("XM repeaters today generate ground-level "dead zones" – muting reception of the Sirius satellite signal.").

[59] XM Comments at 20.

[60] It is interesting to note that while SDARS cites to Commission decisions employing power flux density ("PFD"), equivalent power flux density ("EPFD") or field strength limits, XM and Sirius conveniently ignore that in virtually all such cases, the Commission also employs an EIRP limit to protect other licensees. *See* Sirius Comments at 25-28; XM Comments at 18-20. For example, when the Commission established the Multichannel Video Distribution and Data Service ("MVDDS"), it recognized that an EPFD limit would not sufficiently protect Direct Broadcast Satellite ("DBS") licensees and thus imposed an EIRP limit "will ensure that DBS entities are not

perfect remedy to interference between WCS and SDARS, limiting EIRP is the best available mechanism for assuring that WCS and SDARS can provide viable service offerings in their spectrum allocations.

Utilization of a 2000 watt average EIRP limit is the better alternative for controlling overload interference from SDARS to WCS, since it will tend to reduce the potential for high-site, high-power SDARS repeaters to have direct line of sight into WCS base station antennas. As Sirius itself has observed in a less guarded moment, "[r]ules limiting transmitter power have historically been necessary in situations where there are widespread dangers of frequency interference and coordination would be impractical."[61] Indeed, the Commission has frequently employed transmitter power limits, rather than field strength limits, to protect against overload interference.[62] Moreover, mandating that SDARS transition back to a standard 2000 watt average EIRP level in the band has the additional benefit of satisfying the requirement of Section 324 of

---

unduly hindered in their ability to acquire customers in areas in close proximity to MVDDS transmit facilities." *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range*, Memorandum Opinion and Order and Second Report and Order, 17 FCC Rcd 9614, 9692 (2002) ["*MVDDS Second Report and Order*"]. When the Commission adopted rules to first permit a Mobile Satellite Service Ancillary Terrestrial Component ("ATC"), the PFD limit it adopted surrounding airports was designed to supplement the more general EIRP level that had been adopted for ATC base stations. *See Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands*, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd 1962, 2039 (2003) ("[a]lthough there may be a few instances where an Inmarsat MET receiver will be overloaded by a nearby ATC base station, we provide further protection by adopting section 25.253(c)(2), which limits ATC base stations to a maximum EIRP level of 14.1 dBW toward the horizon to protect other MSS system METs from overload interference."). In the case of the lower 700 MHz band, the Commission restricted operation to a maximum effective radiated power limit to avoid overload interference, in addition to adopting a PFD limit. *See Reallocation and Service Rules for the 698-746 MHz Spectrum Band (Television Channels 52-59)*, Report and Order, 17 FCC Rcd 1022, 1064-65 (2002) ["*Lower 700 MHz Service Rules R&O*"].

[61] Reply Comments of CD Radio, IB Docket No. 95-91 at 2 (filed Jan. 21, 1998).

[62] *See, e.g.*, 47 C.F.R. §§ 24.132 (PCS), 27.50(d) (AWS), 27.50(h) (BRS/EBS).

the Communications Act that "all radio stations . . . shall use the minimum amount of power necessary to carry out the communication desired."[63]

As is discussed below, there is no precedent for now imposing a ground level field strength requirement on WCS, where the spectrum has consistently been governed by an EIRP limit and business plans would be severely disrupted were the Commission to reverse course and subject WCS to the overly-restrictive field strength limits being proposed by XM and Sirius. To the contrary, we establish below that the Commission has taken care not to impose new field strength limits on incumbent licensees. However, as the WCS Coalition has previously advised the Commission, if the Commission is disposed towards adopting a ground level field strength limit for SDARS terrestrial repeaters (which are distinguishable from WCS base stations because SDARS terrestrial repeaters have never been subjected to an EIRP-based permanent rule), then that ground level field strength limit must be appropriately set to provide adequate protection to WCS base stations located far above the two meter measurement point proposed by XM and Sirius.[64]

More specifically, to protect WCS base stations, the Commission should require SDARS terrestrial repeaters to maintain their field strength to no more than 104 dBµV/m (the signal strength that will cause a WCS C or D Block base station receiver to overload)

---

[63] 47 U.S.C. § 324. Moreover, it must be reiterated that although the WCS Coalition prefers use of an EIRP restriction, it is not unalterably opposed to the use of a field strength limit to govern interference in the band, so long as the limit and measurement height chosen are appropriate for protecting WCS base stations, as well as SDARS receivers, and so long as the limits do not foreclose the offering of competitive WCS mobile wireless broadband services.

[64] *See* WCS Compromise Proposal at 6 n.15. ("For the reasons set forth *supra* note 7, the WCS Coalition believes that restrictions on transmit power, rather than average signal strength levels, will best provide for coexistence between the services. However, if the Commission is disposed towards adopting a signal strength limit, that signal strength limit should assure protection of WCS base stations that will be located far above the 2 meter measurement point proposed by Sirius.").

measured 30 meters above ground level at any distance beyond the radiation center height above ground level from the base of the SDARS repeater antenna. This approach will *not* provide full protection to all WCS base stations – many will be located higher above ground level than 30 meters and thus subjected to stronger interfering signals than are present at 30 meters above ground level. However, some height above ground must be chosen for purposes of a rule, and 30 meters is not an unreasonable compromise.

Recognizing that the taking of measurements at such a height can be difficult, an alternative might be to restrict SDARS terrestrial field strength to 64 dBµV/m measured two meters above ground level at any distance beyond the radiation center height above ground level from the base of the SDARS repeater antenna. For the reasons discussed in more detail in Section II.B.1 above, to establish a ground level signal strength requirement that is protective of base stations, one must adjust the 104 dBµV/m WCS base station overload point to reflect the additional attenuation that can be expected in urban environments between two meters above ground as compared to the rooftops where WCS base stations will largely be mounted. Although the difference in attenuation can be substantially greater in some situations, assuming that the additional attenuation will often be on the order of 40 dB is also a reasonable middle ground. Thus, if the Commission is disposed towards establishing a maximum SDARS repeater ground level signal strength, the maximum ground level signal strength limit should be set at 64 dBµV/m (104 dBµV/m minus 40 dB of reduced attenuation) to afford reasonable, but not absolute, protection to WCS base stations.[65]

---

[65] The WCS Coalition appreciates that such a limit is unlikely to prove popular with XM and Sirius. However, that merely illustrates the flaw in attempting to use a ground level signal strength limit to provide protection to WCS – the appropriate level to protect WCS base stations is too low to mollify the SDARS licensees. As discussed below, the reverse is also true – the

C. *IMPOSITION OF THE SIGNAL STRENGTH LIMITS ON WCS LICENSEES THAT SIRIUS AND XM PROPOSE WOULD ADVERSELY IMPACT WCS SERVICE OFFERINGS.*

In its comments, the WCS Coalition established that no ground level field strength limit should be imposed on WCS operations because of the adverse impact such a limit would have.[66] XM and Sirius, however, not only continue to call for a 100 dBµV/m field strength limit for A and B Block WCS licensees, but now propose to drop the ground level field strength limit for C and D Block WCS licensees to 90 dBµV/m – *just one tenth of that permitted for the A and B Block WCS licensees and one-hundredth that permitted for SDARS repeaters*.[67] Neither of these proposals should be adopted.

This most recent proposal by XM and Sirius must be read against the backdrop of the rules that have governed WCS for more than a decade – rules that have been relied upon by WCS licensees as they have developed and begun to implement their current business plans. When the Commission first established WCS, it imposed no restriction whatsoever on the power of WCS transmissions, other than requiring licensees to maintain their predicted or measured median field strength at any location on the border of a WCS service to no more than 47 dBµV/m unless the parties agree to a different field

---

ground level emission limits that SDARS would impose on WCS make it impossible to deploy commercially viable WCS base station networks.

[66] *See* WCS Coalition Comments at 32-33.

[67] *See* Sirius Comments at 29; XM Comments at 34. Particularly preposterous is the suggestion by XM and Sirius that they have only just now determined that a 90 dBµV/m ground level signal strength must be imposed on the WCS C and D Blocks to protect SDARS. While they proclaim this incredibly restrictive limit is needed because the C and D Blocks are immediately adjacent to SDARS (*see* Sirius Comments at 29; XM Comments at 34.), the proximity of the C and D Blocks to SDARS can hardly be news to XM and Sirius – the blocks were placed adjacent to the SDARS spectrum allocation in 1997 when the Commission first created SDARS and WCS, and they were adjacent to the SDARS when Sirius filed its petition for rulemaking. Once again, one can only conclude that the true objective of XM and Sirius here is to cripple the utility of WCS spectrum to serve their own objectives.

strength.[68] Although SDARS interests participated extensively in that proceeding, they sought neither an EIRP limit nor a field strength limit on base stations or fixed or mobile user stations to protect SDARS receivers from WCS interference.

Subsequently, at the request of the Multipoint Distribution Service ("MDS") and Instructional Television Fixed Service ("ITFS") communities, the Commission reconsidered the WCS technical rules and imposed the current 2000 watt EIRP limit as a means of protecting MDS/ITFS video downconverters from overload interference.[69] Although SDARS interests participated in the reconsideration phase of the proceeding, they again made no suggestion that an EIRP limit or ground level field strength restriction was necessary to protect their receivers. Simply put, as WCS and SDARS were being established by the Commission in parallel, XM and Sirius gave no indication that anything more than OOBE restrictions were necessary to protect their service offerings from WCS interference.

For more than a decade, then, the Commission's rules have restricted WCS to 2000 watt fixed and 20 watt mobile EIRP limits,[70] and have imposed no restriction whatsoever on WCS field strength at ground level. As XM and Sirius deployed their satellite and terrestrial networks, and developed their receivers, they knew that the Commission's Part 27 regulatory regime allowed WCS licensees to deploy cellularized networks that would generate relatively high field strength levels near the ground. And they knew that under that regulatory regime, it would be up to the SDARS licensees to

---

[68] *See WCS Report and Order*, 12 FCC Rcd at 10864.

[69] *See WCS Reconsideration Order*, 12 FCC Rcd at 3983-84. At the same time, the Commission also adopted the current provision of Section 27.50(a)(3), which limits mobile and radiolocation mobile stations to 20 watts EIRP peak power. The attempt by Sirius and XM to overturn that requirement is addressed below in Section II.D.

[70] *See* 47 C.F.R § 27.50(a).

develop their own mechanisms to protect against WCS overload interference, since the rules provided SDARS with no recourse. As such, the recent calls by XM and Sirius for the Commission to restrict WCS ground level field strengths to protect SDARS are difficult to take at face value. Indeed, it is impossible to square their current position with Sirius' candid admission that:

> The technical parameters imposed on WCS transmitters by the FCC were based on sound physics whose principles remain unchanged. Satellite radio operators relied on those policies and standards. *Both satellite radio licensees designed, built and deployed their systems to withstand interference that could be anticipated from Part 27-compliant systems*.[71]

Since the current Part 27 rules do not restrict field strength at ground level, since the WCS community has relied on those rules to develop their business plans,[72] and since the quoted language establishes that XM and Sirius have immunized their system design against overload interference from WCS operations that comport with the current rule, there is no public interest benefit in imposing ground level field strength limits that would undermine the ability of WCS licensees to provide broadband services to the public.

There should be no doubt in the Commission's mind that adoption of the ground level signal strength proposals advocated by SDARS would undermine the ability of WCS licensees to provide broadband services to the public. As the WCS Coalition explained in more detail in its initial comments, base stations in a cellularized network will tend to be lower to the ground and to utilize significant downtilt to facilitate spectrum reuse and assure ubiquitous coverage, making it difficult for WCS to meet even

---

[71] Sirius Comments at 17.

[72] *See* WCS Coalition Comments at 27-28.

a 100 dBµV/m ground level signal strength restriction and still provide the sort of high quality, ubiquitous service the public demands.[73]

To illustrate the point, Attachment D is a report on modeling that was conducted by NextWave to estimate the impact that adoption of the SDARS's proposed ground level signal strength limits would have on system design. This report looks at a hypothetical deployment in the Miami, FL area, and identifies the additional number of base station sites that would be required were various SDARS's proposals adopted. As can be seen, if a WCS licensee were required to comport with a 100 dBµV/m ground level field strength limit (and assuming no change in the rules applicable to mobile/portable power levels), more than twice the number of base stations would be required than are required under the current rules.[74] And, as problematic as a 100 dBµV/m ground level field strength limit would be for A and B Block licensees, the 90 dBµV/m limit that XM and Sirius are now proposing for the C and D Block WCS licensees would be devastating – more than six times the number of base stations would be required than under the current rules![75] At the risk of putting too fine a point on it,

---

[73] *See* WCS Coalition Comments at 31-32. As noted *supra* at note 43, this will be true whether the WCS licensee is providing a fixed service or a mobile service. While it is claimed by SDARS that there will be substantial differences in the design of fixed and mobile WCS networks (*See* Sirius Comments at 17; XM Comments at 29-30), in fact base station designs for the two types of networks are converging. For example, while Sirius and XM go to great length to differentiate between systems with a one degree downtilt and ten degree downtilt, suggesting that fixed systems will use the former and mobile systems the latter, neither claim is accurate. *See* Sirius Comments, Ex. A, at 4-5, Appendix 3; XM Comments, Ex. A at 6-7, Appendix 3.

[74] As shown in Attachment D, 120 base stations are required for the baseline deployment designed under the current rules, but 253 base stations would be required under scenario WCS #3, which is the designation for imposing a new 100 dBµV/m ground level emission requirement on WCS base stations while retaining the existing mobile/portable rules.

[75] Attachment D illustrates that, while the same 120 base stations are required for the baseline deployment designed under the current rules, 730 base stations would be required under scenario WCS #4, which is the designation for imposing a new 90 dBµV/m ground level emission

either approach would make it impossible for the resulting system to be a commercial success in the marketplace.

To further illustrate the damage that would be done by adoption of the SDARS proposal, Attachment E provides the deployment plans for the actual wireless broadband network that is currently being constructed by NextWave to serve the Las Vegas market, for which it holds the A Block, C Block and D Block. Under the present network design, 147 base stations are being deployed by NextWave to serve the market with a broadband service compliant with the IEEE 802.16e-2005 mobile standard. Illustrating how far from reality the SDARS proposal is, every single one of those base stations would violate both the 90 dBµV/m limit that SDARS now proposes for NextWave's C and D Blocks and the 100 dBµV/m limit SDARS proposes for NextWave's A Block.[76] Using the same sort of analysis as is presented in Attachment D, if NextWave were required to comport with the rules being proposed by SDARS and still maintain its current projected throughput and in-building penetration levels, it will be required expand the number of base stations more than sixfold to almost 900 base stations in the Las Vegas market alone. The initial and ongoing costs associated with such an endeavor would render the system non-economic.

---

requirement on C and D Block WCS base stations while retaining the existing mobile/portable rules.

[76] The areas surrounding each base station shown in green exceed a 100 dBµV/m ground level signal strength, while the composite of the areas shown in blue and green exceed a 90 dBµV/m ground level signal strength. Page 1 of Appendix E illustrates the entire planned deployment. Page 2 provides a magnified view of a portion of the deployment, while Pages 3 and 4 provide magnified views of two typical base stations. These magnified views illustrate that the size of the area in which the WCS signal will violate the 90/100 dBµV/m benchmark proposed by XM and Sirius far exceeds the small exception area they would allow at the base of the antenna site.

Rather clearly, subjecting WCS to the ground level signal strength limits being proposed by XM and Sirius long after the spectrum was first licensed would have a dramatic adverse impact on licensee business plans to meet the public demand for wireless broadband services. The WCS Coalition does not doubt that in appropriate circumstances, ground level field strength limits can be a useful tool in controlling interference between services. However, the precedents cited by XM and Sirius to support their proposed imposition of ground strength limits are all distinguishable because *in none of those cases did the FCC impose a ground level field strength limitation on an existing service. To the contrary, in every case the ground level field strength limit was imposed on a new service, where licensees would be well-aware of the limitations imposed by the ground level field strength limit before acquiring the spectrum.*

For example, where the Commission imposed a PFD limit on ATC transmitters to protect satellite receivers aboard aircraft on the ground, that limit was adopted in conjunction with the awarding of ATC operating authority, and thus there was no risk that the PFD limit would unfairly impact existing business plans.[77] The same was true when the Commission imposed an EPFD limit on the MVDDS – the EPFD requirement was adopted prior to the issuance of any MVDDS competitive bidding, and thus applicants for the spectrum were well aware that their ability to provide services that required high power levels near ground level was constrained.[78]

---

[77] *See* Sirius Comments at 28 *and* XM Comments at 18, *citing Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands*, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd 1962, 2040 (2003).

[78] *See* XM Comments at 19, citing *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the*

Indeed, the Commission's approach to the imposition of PFD limits in the 700 MHz band is highly instructive, *as the Commission went to great lengths to avoid imposing new limits on incumbent licensees that had secured their authorizations when no such limits were in place.* Several 700 MHz channel blocks had been licensed prior to 2007,[79] and when in 2007 the Commission adjusted its regulatory regime for the 700 MHz band in preparation for Auction 73 and imposed new rules to govern power, it specifically refused to reduce the power at which incumbent 700 MHz licensees could operate.[80] Particularly given the dramatic impact that adoption of the restrictions XM and

---

Ku-Band Frequency Range, Memorandum Opinion and Order and Second Report and Order, 17 FCC Rcd 9614 (2002). The MVDDS case can further be distinguished because, unlike the situation here where there is only a small frequency separation between SDARS terrestrial operations and WCS, the Commission took note of the fact that NGSO FSS was authorized to use the entire 11.7-12.7 GHz band, that MVDSS was limited to just the 12.2-12.7 GHz band, and that NGSO FSS could therefore avoid any interference using spectrum far removed from the MVDSS band in areas where interference would otherwise occur. *See MVDDS Second Report and Order*, 17 FCC Rcd at 9659 ("First-in NGSO FSS receivers will be afforded full use of the entire 11.7-12.7 GHz band with significantly reduced need to rely upon frequency diversity as a result of the conservative spacing requirements we adopt between MVDDS transmitting antennas and pre-existing NGSO FSS receivers. NGSO FSS receivers that are later installed within an existing MVDDS service area, particularly those sited within 3 km of existing MVDDS transmitting antennas, may experience some degree of in-band interference that could encumber NGSO FSS operation in the 12.2-12.7 GHz band. However, NGSO FSS receivers would still have access to the remaining 500 MHz of spectrum in the lower 11.7-12.2 GHz band for downlink service. As a result, later-in NGSO FSS receivers could utilize frequency diversity techniques so that they will not be precluded from operation even in areas where MVDDS operation has already been established.").

[79] The Commission's 2000 Upper 700 MHz *First Report and Order* adopted ERP-based power limits (with no PFD limit) for commercial Upper 700 MHz licensees. *See Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules*, First Report and Order, 15 FCC Rcd 476, 521-22 (2000). The same year the Commission adopted its Upper 700 MHz *Second Report and Order*, requiring 700 MHz Guard Band licensees to comply with the power limits adopted in *First Report and Order* for commercial Upper 700 MHz licensees. *See Service Rules for the 746-764 and 776-794 MHz Bands, and Revisions to Part 27 of the Commission's Rules*, Second Report and Order, 15 FCC Rcd 5299, 5341 (2000). Two years later, the Commission's Lower 700 MHz *Report and Order* imposed a PFD limit only on those Lower 700 MHz licensees that operate base stations in excess of 1 kW. *Lower 700 MHz Service Rules R&O*, 17 FCC Rcd at 1064.

[80] *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, 8100 (2007) ["*700 MHz Report and*

Sirius are proposing on WCS deployments, WCS licensees are entitled to no less consideration.

D. ADOPTION OF THE POWER RESTRICTIONS PROPOSED FOR WCS MOBILE AND PORTABLE DEVICES WOULD EFFECTIVELY PRECLUDE VIABLE TWO-WAY SERVICES IN THE BAND.

Another example of how SDARS is proposing rules designed to effectively preclude WCS mobile operations is the latest proposals by XM and Sirius for restricting WCS mobile device power levels, which currently can transmit at up to 20 watts peak EIRP pursuant to Section 27.50(a)(2) of the Commission's Rules.

In Sirius's petition for rulemaking, it proposed that WCS mobile devices be restricted to power levels of -44 dBm measured just one meter from the antenna.[81] As the WCS Coalition made clear both when it advanced its proposal and in its comments in response to the *Notice*, adoption of this proposal would effectively preclude the offering of two-way services in the band.[82] It explained that while WiMAX mobile subscriber equipment must transmit power levels in the range of several hundred milliwatts to ensure two-way communication with a base station, Sirius' initial proposal would restrict WCS subscriber equipment transmit power to about *0.4 milliwatts*, at best (assuming a 0 dBi antenna and 5 MHz measurement bandwidth). As Motorola succinctly put it, the

---

Order"] ("we conclude that it would not be appropriate to reduce the power limits of incumbent Lower 700 MHz Band licensees, who acquired their spectrum with the expectation that they would be able to employ 50 kW ERP transmissions in the band."); *id* at 8101 (increasing the maximum permissible ERP for the Upper 700 MHz band from 1 kW to 2 kW, and requiring only systems operating above 1 kW to comply with new PFD restriction).

[81] *See* Sirius Petition at Ex. B Appendix 1.

[82] *See* WCS Compromise Proposal at 3 n.7; WCS Coalition Comments at 30.

SDARS proposed restriction on WCS user stations "would unduly constrain the power levels of WCS terminal to a level that would make the WCS service not viable."[83]

Consistent with the SDARS *modus operandi* in this proceeding, XM and Sirius now abandon their own proposed limit on WCS mobile operations, and advance a new proposal that while different, is no better. Now, XM and Sirius would have the Commission repeal Section 27.50(a), which allows mobile devices to operate at up to 20 watts peak EIRP, and replace it with a rule limiting mobile and portable devices (which they define as any device that can be battery operated) to power levels of 10 milliwatts (10 dBm) if operating on the A and B Blocks, and to 1 milliwatt (0 dBm) if operating on the C and D Blocks.[84] Suffice it to say that these power levels are far too low to permit WCS licensees to provide a viable mobile or portable wireless broadband service to the public.

Again, some background is necessary. As discussed above in Section II.C of these reply comments, the current rule allowing WCS mobile devices to operate at up to 20 watts peak EIRP was adopted more than a decade ago along with the other current WCS power rules, without objection from the SDARS community.[85] At the risk of repeating the argument advanced above regarding WCS base station power levels, the fact is that for the past eleven years, *the Commission's rules have allowed WCS A and B Block mobile and portable stations to operate at 2,000 times the power proposed by SDARS, and have allowed WCS C and D Block mobile and portable stations to operate at 20,000 times the power proposed by SDARS*. As the XM and Sirius satellite and

---

[83] Motorola Comments at 7.

[84] *See* XM Comments at 34.

[85] 47 C.F.R. § 27.50(a)(2).

terrestrial networks were being designed, and as they were developing their receivers, XM and Sirius were fully aware that Section 27.50(a)(2) allowed these EIRP levels, and that devices operating at high EIRP level could be located in proximity to their receivers. And they knew that under the Commission's regulatory regime for WCS, it would be up to the SDARS licensees to develop their own mechanisms to protect against WCS overload interference, since the rules provided SDARS with no recourse against overload interference that might be caused were one of their subscribers to come within proximity of a WCS mobile or portable device. Again, one is hard pressed to square SDARS's current demand for protection against WCS overload interference with Sirius' assertion that "[b]oth satellite radio licensees designed, built and deployed their systems to withstand interference that could be anticipated from Part 27-compliant systems."[86] If that is the case, then why the sudden call for onerous new restrictions on WCS user equipment? Is it because XM and Sirius know that by skimping on receiver costs they have subjected themselves to overload interference, and are hoping for the Commission to bail them out at the expense of WCS licensees and the public demand for wireless broadband? The Commission should not take that bait.

While the WCS Coalition has been prepared to make reasonable concessions to the SDARS community, their current proposal is beyond the pale. Adoption of the 1 milliwatt/10 milliwatt proposal now being advocated by SDARS would effectively preclude WCS licensees from providing the very types of broadband services the public is demanding. Reducing the power level of user devices, of course, has an immediate impact on network costs -- more base stations are required because base stations will now

[86] Sirius Comments at 17.

have to be closer to users to hear the less power signals from user devices. And that not only increases initial capital expenses, it increases ongoing site lease costs, maintenance costs and backhaul expenses (since more base stations require more backhaul links). In this case, the impact on costs would effectively preclude the deployment of wireless broadband systems.

Attachment D illustrates the potential impact that adoption of these proposed WCS power limits would have on WCS deployment. For a system that utilizes just the A and B Block WCS channels, adoption of the latest SDARS proposal would require the installation of more than four times the number of base stations in the system.[87] And, not surprisingly, the problem becomes even worse if the system utilizes the C or D Block – *almost thirteen times the number of base stations will be required.*[88] In other words, were the Commission to adopt the 1 milliwatt/10 milliwatt limits on WCS mobile and portable transmitters that SDARS proposes, the increased network infrastructure costs will effectively preclude the provision of two-way wireless broadband services over the WCS spectrum. While that may service SDARS's narrow self-interest, it is impossible to square such a result with the public interest.

---

[87] Attachment D shows that while just 120 base stations are required for the baseline deployment designed under the current rules, 529 base stations would be required under scenario WCS #1, which is the designation for imposing a new 10 dBm power limit on WCS mobile units operating on the A and B Block, while retaining the existing base station power rules.

[88] Again, while 120 base stations are required for the baseline deployment designed under the current rules, 1537 would be required under scenario WCS #2, which is the designation for imposing a new 0 dBm power limit on WCS mobile units operating on the C and D Block, while retaining the existing base station power rules.

E. THE COMMISSION SHOULD PERMIT AVERAGE MEASUREMENT OF THE 2000 WATT EIRP LIMIT FOR WCS.

In its attempt to reach a compromise resolution to the matters pending before the Commission in this proceeding, the WCS Coalition has recently indicated to the Commission its willingness to accept rules under which WCS and SDARS will be required to meet a 2000 watt *average* EIRP limit, rather than the 2000 watt *peak* EIRP limit that the WCS Coalition had previously endorsed, subject to a 400 watts average EIRP per megahertz power spectral density limit.[89] Curiously, however, although the compromise would permit XM and Sirius to transmit with higher power than the WCS Coalition's prior position, they now oppose permitting WCS licensees to utilize average measurement techniques in establishing compliance with a 2000 watt EIRP limit.[90]

This current opposition is impossible to reconcile with prior filings by XM and Sirius. For example, in WT Docket No. 03-264, the "wireless streamlining" proceeding, XM submitted comments that expressed "support [for] the Commission's proposal to amend its rules to specify the EIRP limit for base stations in Parts 24 and 27 of the rules in terms of average power."[91] It noted that "average power provides a more accurate representation of the interference potential of non-constant envelope technologies, *and*

---

[89] *See* WCS Coalition Comments at 23-25; WCS Compromise Proposal, Ex. A at 1, 3.

[90] *See* Sirius Comments at 18-20; XM Comments at 33.

[91] Joint Reply Comments of WCS Wireless LLC and XM Satellite Radio Holdings Inc., WT Docket No. 03-264, at 7 (filed Jan. 17, 2006) ["XM Wireless Streamlining Reply Comments"]. The WCS Coalition recognizes that one of its members in that proceeding had urged the Commission to retain for WCS the current peak power limitation. *See* Comments of Wireless Communications Ass'n Int'l, Inc., WT Docket No. 03-264 (filed Dec. 19, 2005). However, as explained in the WCS Compromise Proposal and in the WCS Coalition's initial comments, the WCS Coalition is willing to accept higher power operations by SDARS in the interests of compromise, and recognizes that there are substantial benefits to allowing WCS licensees to operate at equivalent power levels. *See* WCS Compromise Proposal at 3-7; WCS Coalition Comments at 23-24.

base stations operating pursuant to an average rather than peak power specification will not cause increased interference."[92] And, XM stressed that "[i]f average power is acceptable for operations of [PCS and AWS] low-powered cellular-like systems, there is no legitimate reason why it should not also be acceptable for operators of similar systems in the 2.3 GHz WCS band, to the extent these systems are deployed."[93] Similarly, in response to a request by a former WCS licensee for a waiver that would permit it to operate at 2000 watts average EIRP, XM and Sirius jointly advised the Commission of their support for the request, so long as the Commission also utilized average measurements to regulate SDARS repeaters (which is exactly what the WCS Coalition has proposed here).[94] One can only speculate as to why XM and Sirius have now changed their tunes – their latest filings provide no explanation.

The WCS Coalition's proposal should be adopted because allowing WCS licensees to operate at 2000 watts average EIRP will not subject neighboring services to any meaningful risk of interference that is not present today. Today, the Commission does not regulate the waveform employed by WCS licensees, and they are free to utilize waveforms with a constant envelope (such as waveform associated with the Global System for Mobile Communications ("GSM")). As a practical matter, this means that a WCS licensee is free to operate multiple GSM carriers, each at 2000 watts average EIRP, because with constant envelope waveforms the peak power and average power levels are equal.

---

[92] XM Wireless Streamlining Reply Comments at 8 (emphasis added).

[93] *Id.*

[94] *See* Comments of Sirius Satellite Radio Inc. and XM Radio Inc., DA 05-1662 (filed July 5, 2005).

Moreover, the WCS Coalition's proposal for use of average measurements is coupled with a proposed power spectral density limit of 400 watts average EIRP per megahertz that will substantially reduce the prospects for interference from WCS. Although ignored by those opposed to the WCS Coalition's proposal, adoption of this power spectral density limit will provide substantial protection against overload interference. Under the current Part 27 rules, a WCS licensee is free to transmit multiple narrow band carriers at 2000 watts peak EIRP each. For example, that GSM employs a constant envelope waveform and utilizes just 200 kHz per channel. As such, a WCS licensee today could operate at a maximum of 50,000 watts composite power (25 GSM channels of 200 kHz each, each transmitted at maximum power). While the individual emissions have a constant envelope waveform, the composite waveform at a victim receiver of all 25 GSM carriers will have a peak to average ratio ("PAR") of 10*log10(25), o r14 dB, which is the greater than the 13 dB PAR limit proposed by the WCS coalition for wideband non-constant envelope signals such as OFDM or CDMA. Another example is 1.25 MHz RF carriers with cdma2000-based technology. Under the Commission's Rules, a WCS licensee could pack four RF channels into a single 5 MHz WCS channel, resulting in a composite 6 dB increase in power over a single carrier running 2000 watts peak EIRP. Thus, the rule that the WCS Coalition proposes results in less potential for overload, not more.

Moreover, the WCS Coalition has previously established that by allowing WCS licensees to transmit at up to 2000 watts average EIRP, the Commission will eliminate the bias in the current rule against using wideband technologies that employ non-constant

envelopes.[95] As the Commission recently concluded in establishing power limits for the 700 MHz band based on average power:

> [a]lthough the use of "average" power will effectively result in an increase in 700 MHz Band power levels for non-constant envelope technologies, such as CDMA and WCDMA, the "average" measurement approach is a more accurate measure of the interference potential for these technologies. *We find that any effective increase in power that would result through the use of an "average" measurement approach will be modest*, and in any event will be outweighed by the benefit of measuring today's technologies using a more realistic and appropriate technique.[96]

Moreover, the WCS Coalition was not alone in recognizing the public interest benefits of utilizing average measurement coupled with a power spectral density limit – Motorola also endorsed the concept.[97]

The Commission's recognition that the use of average measurements will result in substantial benefits without causing undue additional interference is even more true that usual here, where the WCS Coalition has tied its proposal to a new power spectral density limit that, as discussed above, substantially reduce the potential for overload to adjacent channel licensees compared to the current rules. Admittedly, even if the WCS Coalition's proposals are all adopted, there will be situations in which WCS base station transmissions will cause what SDARS calls a "dead zone" surrounding the base station location, just as WCS will inevitably suffer a "dead zone" surrounding SDARS repeaters. However, adoption of those proposals will, on balance, substantially reduce the potential for overload that exists under the current rules.

---

[95] *See* WCS Coalition Comments at 26 n.54.

[96] *700 MHz Report and Order*, 22 FCC Rcd at 8103 (emphasis added).

[97] *See* Motorola Comments at 4-5 ("Motorola supports the WCS Coalition proposal for a 2 kW average EIRP limit for base stations/repeaters in both services . . . . Motorola also supports the proposal to additionally specify the power as a power spectral density (dBW/MHz)…").

F. HAVING ACCEPTED THE RISKS ASSOCIATED WITH CONSTRUCTING HIGH-POWER TERRESTRIAL REPEATERS OVER WCS OBJECTIONS, XM AND SIRIUS SHOULD BE REQUIRED TO BRING REPEATERS THAT DO NOT MEET THE NEW RULES INTO COMPLIANCE.

In the *Notice*, the Commission solicited comment on Sirius' proposal that would permit XM and Sirius not only to continue operating those existing repeaters that do not comport with the final rules adopted in these proceedings, but would remove SDARS' *current absolute obligation to cure any interference that may be caused to future WCS deployments.*[98] Given the record that has already been developed in IB Docket No. 95-91, it is not surprising that the arguments XM and Sirius again trot out to justify allowing continued operation of their existing repeaters (apparently including the hundreds that were constructed in blatant violation of the terms of their STAs), but without retaining their current obligation to cure any interference caused to WCS, do not stand up to scrutiny.

The primary arguments against the SDARS proposal are set forth in the WCS Coalition's initial comments, and need not be repeated in detail here.[99] Ultimately, this issue should turn on one critical question – whether continued operation of the existing repeaters, without retention of the existing obligation for SDARS to cure any interference caused by those repeaters – will cause undue harm to WCS licensees and their subscribers. As the WCS Coalition established in its comments, overload from the existing, over-powered SDARS repeaters imposes significant restrictions on the ability of WCS licensees to deploy base stations in major urban areas. These restrictions result in, at best, substantially increased costs for WCS service and, at worst, an inability to serve

---

[98] *See Notice* at ¶¶ 33-36.

[99] *See* WCS Coalition Comments at 41-50.

areas that no nationwide service can ignore.[100] The WCS Coalition was hardly alone in reaching this conclusion – its position was confirmed by the WiMAX Forum, which established that "SDARS operators, under special temporary authority (STA), have deployed hundreds of terrestrial repeaters at such high transmit power levels that the wireless broadband services planned for deployment in the WCS band are jeopardized."[101]

XM and Sirius would have the Commission ignore the evidence before it regarding the harm caused by over-powered repeaters, and claim that interference to WCS will be much worse if they are required to comply with the rules proposed by the WCS Coalition.[102] While Sirius provides no analysis to substantiate its *in teroreum* assertion, XM cites to the Indianapolis market, which it currently serves with a single repeater that reportedly operates at 10,332 watts average EIRP. XM contends that, if it were required to reduce power to 2000 watts average EIRP, it would deploy an additional 39 repeaters in the market.[103] Obviously, though, Indianapolis is hardly a typical XM market – XM acknowledges that only 228 additional repeaters would be required were

---

[100] *See* WCS Coalition Comments at 48 and Attachment F (illustrating impact of overload from existing SDARS repeaters on deployments in New York City, NY and Washington, DC).

[101] WiMAX Forum Comments at 3. It is worth noting that both XM and Sirius cite to a 2001 XM filing for the proposition that WCS can avoid interference from their over-powered repeater networks. *See* XM Comments, Ex. B at 1 n.1; Sirius Comments, Ex. B at 1 n.1, *citing* Letter from Bruce D. Jacobs, Counsel for XM Radio Inc., to Magalie Roman Salas, Secretary, Federal Communications Commission, IB Docket No. 95-91 (filed Aug. 29, 2001). Suffice it to say that the WCS community has fully refuted the erroneous arguments that XM presented at that time, and in the interest of brevity those showing are incorporated by reference. *See, e.g.*, 2001 WCS Coalition Reply; BeamReach Comments; BellSouth Letter; BeamReach Letter.

[102] *See* Sirius Comments at 36-37; XM Comments at 25-26.

[103] *See* XM Comments at 26 and Ex. B.

the Commission to adopt the WCS Coalition's proposal, and thus almost 20% of the new repeaters XM claims to need would be devoted to this single market.[104]

The record, however, suggests that far fewer additional SDARS terrestrial repeaters would be deployed were the Commission to adopt the WCS Coalition's proposals. One need only review how few repeaters XM has deployed in other markets that are similar in size and characteristics to Indianapolis to conclude that XM may be significantly exaggerating the number of 2000 Watt average EIRP repeaters it would install to serve Indianapolis. For example, in connection with XM's admission of having illegally constructed and operated hundreds of repeaters at variance from the terms of its STAs, XM has informed the Commission that in Columbus, Ohio where the population of the Metropolitan Statistical Area is greater than that of Indianapolis, it only utilizes four repeaters, of which three are operating below 2000 watts and the fourth is only marginally above 2000 watts (2500 watts).[105] In Memphis, a city with a slightly smaller population than Indianapolis, XM currently provides coverage utilizing just seven terrestrial repeaters, five of which operate below 2000 watts and only two of which operate at higher powers (2500 watts and 2900 watts).[106] Certainly, before the Commission accepts XM's claim that it will require 39 repeaters operating at 2000 watts average EIRP to replace its existing over-powered Indianapolis repeater, XM must explain why so many more repeaters are required to serve Indianapolis than to serve other, similar markets.

---

[104] *See id*. at 26.

[105] *See* XM Radio Inc. Supplement No. 2 to Memorandum in Support of STA Request, File No. SAT-STA-20061002-00114, at 10 (filed Dec. 18, 2006).

[106] *See* XM Radio Inc. Supplement No. 3 to Memorandum in Support of STA Request, File No. SAT-STA-20061002-00114, at 9 (filed Jan. 4, 2007).

Equally devoid of merit is the suggestion by XM and Sirius that their grandfathering plan should be adopted to avoid additional expense and disruption.[107] XM and Sirius concede that many of their existing repeaters already comply with the 2000 watt average EIRP limit proposed by the WCS Coalition,[108] and thus complaints about the costs and difficulty of compliance are facially overstated. No doubt, XM and Sirius will have to incur additional expenses and there may have to be temporary disruptions in its repeater operations if the WCS Coalition's approach is adopted. *But that is the risk that XM and Sirius knowingly accepted when they decided to bull ahead with the construction of an over-powered repeater network while the Commission was considering proposals to require repeater operations at much lower levels.*[109] As the WCS Coalition established in its comments, the WCS Coalition had objected to the power levels being proposed by SDARS long before the STAs were granted, and as the *Notice* points out, "the SDARS licensees deployed their repeaters pursuant to grants of special temporary authority that explicitly state that any actions taken under the 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.'"[110]

---

[107] *See* Sirius Comments at 36-37; XM Comments at 26-27.

[108] Sirius admits that approximately 40% of its existing repeater network complies with the WCS Coalition's 2000 watt average EIRP proposal. *See* Sirius Comments at 6. Interestingly, neither XM nor Sirius have elected to provide the Commission with any analysis of whether their existing repeaters comport with either the field strength limits proposed in the Sirius petition for rulemaking or the more relaxed limits they now advocate. Certainly, if the Commission is disposed towards limiting SDARS repeaters with a field strength construct, XM and Sirius should be required to disclose the extent to which their existing repeater network complies before any decision can be made regarding the grandfathering of those existing repeaters.

[109] *See* WCS Coalition Comments at 46-47.

[110] *Notice* at ¶ 33, *citing Sirius 2001 STA Order*, 16 FCC Rcd at 16779 and *XM Radio 2001 STA Order*, 16 FCC Rcd at 16787.

It is worth noting that neither XM nor Sirius even attempt to justify Sirius' earlier proposal to allow the future relocation of non-conforming repeaters within 3 kilometers of their current sites without regard to any potential interference that would be caused to WCS operations. Since XM and Sirius have apparently abandoned this unsupportable proposition, nothing more need be said other than the obvious – even if the Commission decides to implement a long-term grandfathering program, there is no reason for the Commission to extend grandfathering beyond facilities that were constructed pursuant to the existing STAs.

In a related vein, it is perhaps not surprising that, although the *Notice* specifically asks whether any grandfathering should extend to the hundreds of repeaters that were constructed at odds with the STAs,[111] neither XM nor Sirius address the issue. Presumably, the Enforcement Bureau is currently investigating the facts and circumstances surrounding SDARS' unprecedented violation of the Commission's rules governing construction of interim facilities pursuant to STAs. Suffice it to say that, given the magnitude of the violations it is inconceivable that the violations resulted from inadvertent mistakes – one can only conclude from the facts that are available to the public that, during a time when both companies were under intense pressure to launch service, they knowingly elected to construct unauthorized repeaters rather than endure the delay they might suffer if they applied to the FCC for STA modifications. The Commission must think long and hard before it extends grandfathering (without an attendant obligation to cure interference to WCS) to facilities illegally constructed under such circumstances.

---

[111] *See Notice* at ¶ 35.

G. THE COMMISSION SHOULD REJECT THE PROPOSAL BY AFTRCC TO REQUIRE WCS LICENSEES TO ATTENUATE THEIR SIGNALS BY AT LEAST 110 + 10 LOG (P) ABOVE 2360 MHZ.

Section 27.53(a)(3) of the Commission's Rules requires WCS licensees engaged in fixed or mobile operations to attenuate their OOBE into the 2360-2370 MHz band by at least 43 + 10 log (p), and to attenuate their OOBE above 2370 MHz by at least 70 + 10 log (p).[112] AFTRCC, however, now urges the Commission to impose a 110 + 10 log (p) attenuation requirement on all WCS OOBE above 2360 MHz. The Commission should reject that request, which if adopted would have the same preclusive impact on neighboring WCS operations as the current 110 + 10 log (p) mask into the 2320-2345 MHz band has.

Once again, history (this time the history of Section 27.53(a)(3)) is instructive. In the *Notice of Proposed Rulemaking* ("*WCS NPRM*") that first proposed the creation of WCS, the Commission proposed that for fixed operations, all OOBE from fixed WCS facilities be attenuated by 43 + 10 log (p) on all frequencies above 2360 MHz. For mobile operations, the *WCS NPRM* proposed that all WCS OOBE be attenuated by 43 + 10 log (p) between 2360-2370 MHz and by 70 + 10 log (p) above 2370 MHz.[113] AFTRCC participated extensively in response to the *WCS NPRM*, submitting both comments and reply comments addressing, among other things, the potential for WCS to

---

[112] *See* 47 C.F.R. § 27.53(a) (3) (attenuation required "*For fixed, land, mobile, radiolocation land and radiolocation mobile stations:* By a factor not less than 70 + 10 log (p) dB on all frequencies below 2300 MHz and on all frequencies above 2370 MHz; and not less than 43 + 10 log (p) dB on all frequencies between 2300 and 2320 MHz and on all frequencies between 2345 and 2370 MHz that are outside the licensed bands of operation").

[113] *Amendment of the Commission's Rules to Establish Part 27 of the Wireless Communications Service ("WCS")*, Notice of Proposed Rulemaking, 11 FCC Rcd 21713, 21731 (1996) ["*WCS NPRM*"].

interfere with telemetry operations.[114] When the Commission ultimately adopted final rules to govern WCS OOBE in 1997, it required both fixed and mobile WCS systems to attenuate OOBE by at least 43 + 10 log (p) between 2360-2370 MHz and by at least 70 + 10 log (p) above 2370 MHz.[115] AFTRCC did not petition for reconsideration of that decision or otherwise indicate that its telemetry constituents would be unable to address the OOBE that WCS was permitted to create under the new rules.

Thus, since 1997, those operating telemetry systems above 2360 MHz have been on notice that they would be required to exist in an environment in which WCS licensees operating in the adjacent spectrum would be required to attenuate OOBE by at least 43 + 10 log (p) between 2360-2370 MHz and by at least 70 + 10 log (p) above 2370 MHz. The Commission's decision regarding WCS OOBE limits into telemetry was hardly an aberration. The need for telemetry operators to protect themselves against adjacent channel interference was driven home again five years later when, in 2002, the Commission reallocated the 2385-2390 MHz for a Part 27 fixed and mobile service that would operate adjacent to telemetry (just as WCS does).[116] Under the Part 27 rules for that service, licensees were required to attenuate their OOBE by 43 + 10 log (p) into the telemetry band.[117] Although the Commission ultimately reversed that allocation and returned the spectrum for exclusive use by the telemetry community as part of an

---

[114] *See* Comments of Aerospace and Flight Test Radio Coordinating Council, GN Docket No. 96-228 (filed Dec. 4, 1996); Reply Comments of Aerospace and Flight Test Radio Coordinating Council, GN Docket No. 96-228 (filed Dec. 16, 2006).

[115] *See WCS Report and Order*, 12 FCC Rcd at 10854.

[116] *See Amendments to Parts 1, 2, 27 and 90 of the Commission's Rules to License Services in the 216-220 MHz, 1390-1395 MHz, 1427-1429 MHz,1429-1432 MHz, 1432-1435 MHz, 1670-1675 MHz, and 2385-2390 MHz Government Transfer Bands,* Report and Order, 17 FCC Rcd 9980 (2002) ["*27 MHz Report and Order*"].

[117] *See id.* at 10046.

arrangement to free spectrum from government use for the Advanced Wireless Service, the message to AFTRCC and its constituents could not have been more clear.

With this history in mind, it can readily be seen that to the extent, if any, that AFTRCC's constituents truly are vulnerable to possible interference from WCS, it is because they have failed over the past eleven years to protect themselves from WCS operations permissible under the existing rules. AFTRCC would have the Commission believe that the proposal by the WCS Coalition to afford a limited class of low-powered user stations relief from the OOBE restrictions applicable to the 2320-2345 MHz SDARS band "would increase dramatically the risk of interference to flight test telemetry."[118] The logic of that argument, however, is illusive -- the WCS Coalition has never proposed, and is not now proposing, any change whatsoever in the OOBE restrictions contained in Section 27.53(a)(3). *Under the WCS Coalition proposal, WCS OOBE would still have to be attenuated by at least 43 + 10 log (p), and to attenuate their OOBE above 2370 MHz by at least 70 + 10 log (p), just as it is today.*[119]

AFTRCC bases its filing on the fear that portable and mobile "devices, together with fixed subscriber stations, could be located at street level, or in the upper stories of high-rise office or apartment buildings, with a clear view of telemetry ground stations."[120] While AFTRCC is absolutely right, such is the case today, and such has been the case since the WCS rules were first adopted in 1997. Today, without any change in the rules, a WCS licensee is free to deploy mobile, portable, fixed consumer and/or base stations

---

[118] Comments of Aerospace and Flight Test Radio Coordinating Council, WT Docket No. 07-293, at 2 (filed Feb. 14, 2008) ["AFTRCC Comments"].

[119] *See* WCS Compromise Proposal, Ex. A at 1-2.

[120] AFTRCC Comments at 4.

that can be in very close proximity to a telemetry receiver, provided the OOBE restrictions of Section 27.53(a)(3) are met. If, as AFTRCC suggests, its constituents are vulnerable to interference from WCS, it is because they have failed to install appropriate filters and take other steps to protect against WCS operations that have been permitted under Part 27 for more than eleven years now.[121] Adoption of the WCS Coalition's proposed rule changes are not the problem here – it is the failure of the telemetry community to adapt to the Commission's 1997 rulings.

Moreover, there is no merit to the suggestion by AFTRCC that the existing 110 + 10 log (p) spectral mask at 2320-2345 MHz provided "de facto protection for the AMT band as well."[122] Because the 110 + 10 log (p) spectral mask at 2320-2345 MHz is so difficult to meet, were one to manufacture a mobile device to operate on the entire WCS band today, one would employ a notch filter to block OOBE into the 2320-2345 rather than a band pass filter. That notch filter at 2320-2345 MHz would have no impact on OOBE above 2360 MHz – the device designer would employ other means to attenuate OOBE by at least 43 + 10 log (p), and to attenuate OOBE above 2370 MHz by at least 70 + 10 log (p).

In light of AFTRCC's arguments here, its contention that the Commission should require WCS licensees to engage in prior coordination with telemetry interests before constructing any base station within line of sight of a telemetry receiver is a sham.[123] AFTRCC's engineering statement concludes that "[n]o [coordination] approach is

---

[121] This failure is startling given the vulnerability to interference that AFTRCC claims telemetry receivers suffer. If, as AFTRCC suggests, a single mobile WCS device will cause interference to any telemetry receiver within 100 kilometers to which it has line of sight (*see id*.), one has to wonder how AFTRCC plans to coexist with any operations in the WCS band.

[122] *Id*., Engineering Statement at 3.

[123] *See id*. at 6.

practical in the case of mobile, portable, and low power fixed subscriber units,"[124] and thus one can only wonder as to what a coordination process would entail. Is AFTRCC proposing that it be given an absolute veto over WCS deployment of mobile, portable and fixed consumer services to compensate for AFTRCC's failure to adjust its operations to comply with rules that are now 11 years old? In any event, the Commission rejected a similar proposal from AFTRCC for adjacent channel coordination when it allocated the 2385-2390 MHz band for a Part 27 fixed and mobile service in 2002, finding that it was "onerous and potentially harmful to the viability of operations." [125] That finding is equally applicable here, and AFTRCC has failed to provide any rationale for the Commission to reverse course.

Finally, while AFTRCC has proposed a maximum PAR of 6-8 dB, such a limit would be unduly limiting.[126] As Motorola has pointed out, "current OFDM technologies have a PAR around 10 dB" and a maximum WCS/SDARS PAR of 13 dB is necessary "to allow licensees technological flexibility as was afforded in the 700 MHz proceeding."[127] The Commission has recognized that a 13 dB maximum PAR, which was also proposed by the WCS Coalition, "strikes a balance between enabling licensees to use modulation

---

[124] *Id.*, Engineering Statement at 3.

[125] *See 27 MHz Report and Order*, 17 FCC Rcd at 10045 ("Although we recognize the importance of aeronautical flight test telemetry, we believe that imposing AFTRCC's coordination requirements on licensees in the 1432-1435 MHz and 2385-2390 MHz bands would be onerous and potentially harmful to the viability of operation in these bands overall.").

[126] *See* AFTRCC Comments at 6 n.6. In addition, there is no merit to AFTRCC's suggestion that OOBE limits should be applied to the EIRP of a system, rather than transmitter output power. *See id.* AFTRCC has provided no explanation whatsoever of why the Commission should abandon for WCS the approach to OOBE regulation applied to every other Part 27 service, and no benefit to the public is readily apparent. The Commission rejected this approach when it adopted Section 27.53(a)(3) in 1997 (*see WCS Report and Order*, 12 FCC Rcd at 10852 (noting AFTRCC contention that antenna gain had to be considered when calculating OOBE compliance).

[127] Motorola Comments at 5.

schemes with high PARs (such as OFDM) and protecting other licensees from high PAR transmissions."[128]

III. CONCLUSION.

The Commission's objective in this proceeding was stated succinctly in the *Notice* -- to craft rules "that would allow SDARS terrestrial repeaters and WCS operation to coexist in adjacent bands."[129] The proposals advanced by XM and Sirius bear no relationship to that goal, as at every turn they would have the Commission adopt new rules designed to frustrate the business plans of WCS licensees and assure that the 2305-2320 MHz and 2345-2360 MHz bands remain underutilized. By contrast, the WCS Coalition has demonstrated that its proposed relaxation of OOBE restrictions imposed on a limited subset of user devices will not result in undue OOBE interference to SDARS listeners. And, it has demonstrated that a 2000 watt average EIRP limit on WCS base stations and SDARS repeaters best facilitates coexistence. While our solution will not provide SDARS or WCS with an interference-free environment, it is exactly what the Commission envisioned when it announced its intent "to limit the potential for interference to a reasonable level -- not to provide a pure, interference-free environment."[130] As such, the WCS Coalition reiterates its call for the Commission to adopt the Part 25 and Part 27 rule revisions we have advanced in our compromise proposal, our initial comments in response to the *Notice* and herein.

---

[128] *700 MHz Report and Order*, 22 FCC Rcd 8103-04.

[129] *Notice*, App. A at 1. *See also id.* at ¶ 3.

[130] *WCS Reconsideration Order*, 12 FCC Rcd at 3991 (emphasis added).

Respectfully submitted,

THE WCS COALITION

By: /s/ Paul J. Sinderbrand_____
Paul J. Sinderbrand
Mary N. O'Connor

Wilkinson Barker Knauer, LLP
2300 N Street, NW
Suite 700
Washington, DC 20037-1128
202.783.4141

Its Attorneys

March 17, 2008

ATTACHMENT A

Analysis of the SDARS Proposed
WCS Mobile CPE Out-of-Band Emission (OOBE) Mask

XM and Sirius have asserted that any WCS mobile CPE OOBE mask requires attenuation into the 2320-2345 MHz band by at least 102.7 + 10 Log (P).[1] However, this claim is not based on actual field testing, but instead is based on calculations using a suspect receiver noise level measurement, as well as an incorrect pathloss equation. Moreover, in calculating its protection requirements, SDARS has not taken into account the unique nature of the Coalition stepped mask, the effects of low duty cycle or the benefits of mandatory transmit power control in WCS mobile devices. Therefore, while XM and Sirius speculate about what WCS CPE OOBE mask would be required to protect their receivers based on conjecture and flawed noise floor measurements, reports being filed by the WCS Coalition in its reply comments establish that the WCS Coalition has tested its mask proposal in the field and validated the effectiveness of its proposed mask in protecting SDARS receivers at three meters separation from a WCS mobile device. While the erroneous pathloss and noise floor values are not the only reasons that the SDARS proposed mask is overly protective, they are the focus of the following discussion because of the magnitude of the error they introduce into the discussion.

Pathloss Discussion

SDARS claims that the applicable pathloss equation for the interference scenarios is free space + 3 dB. Although a Verizon comment in WT Docket 07-195 is cited as the source of this equation,[2] XM and Sirius offer no discussion as to why this equation is applicable to the current proceeding, nor do they validate the equation with testing. The equation they have chosen results in a 3 meter predicted pathloss of 52.2 dB, a number that, as shown below, does not accurately reflect the significantly higher pathloss measured during field testing.

Two independent test programs by ATECS, LLC and NextWave Wireless Inc. that were conducted in three different locations (two in Virginia and one in California) have shown that the actual pathloss between mobile CPE at separations distances up to 33 meters is significantly higher than XM and Sirius claim. In fact, at the three meter distance, this field testing shows that the actual pathloss is 61.4 dB. This actual pathloss value is based upon the WCS Coalition's field-tested equation Pathloss = 50.9 + 21.8 Log (d) dB, and indicates a significantly higher pathloss than the 52.2 dB derived by SDARS' use of an inapplicable and invalid equation. The 9.2 dB pathloss difference,when applied to the SDARS mask calculation methodology, decreases the required mask attenuation accordingly.

---

[1] See Comments of XM Radio Inc., WT Docket No. 07-293, at 32 (filed Feb. 14, 2008)("*XM Comments*"); Comments of Sirius Satellite Radio Inc., WT Docket No. 07-293, Ex. A at 16 (filed Feb. 14, 2008)("*Sirius Comments*").
[2] *See XM Comments* at Ex. A.

The testing results from the separate NextWave[3] and ATECS [4] pathloss characterization studies are presented below in Figures 1 and 2, and Table 1. These pathloss results are accurate and repeatable, and support the position that the pathloss between a WCS mobile CPE and an SDARS CPE in close proximity cannot be characterized as "free space + 3 dB" as claimed by SDARS, but is actually much greater. As stated previously, WCS Coalition results show that at only three meters separation, the actual pathloss is 9.2 dB greater than that claimed by XM.

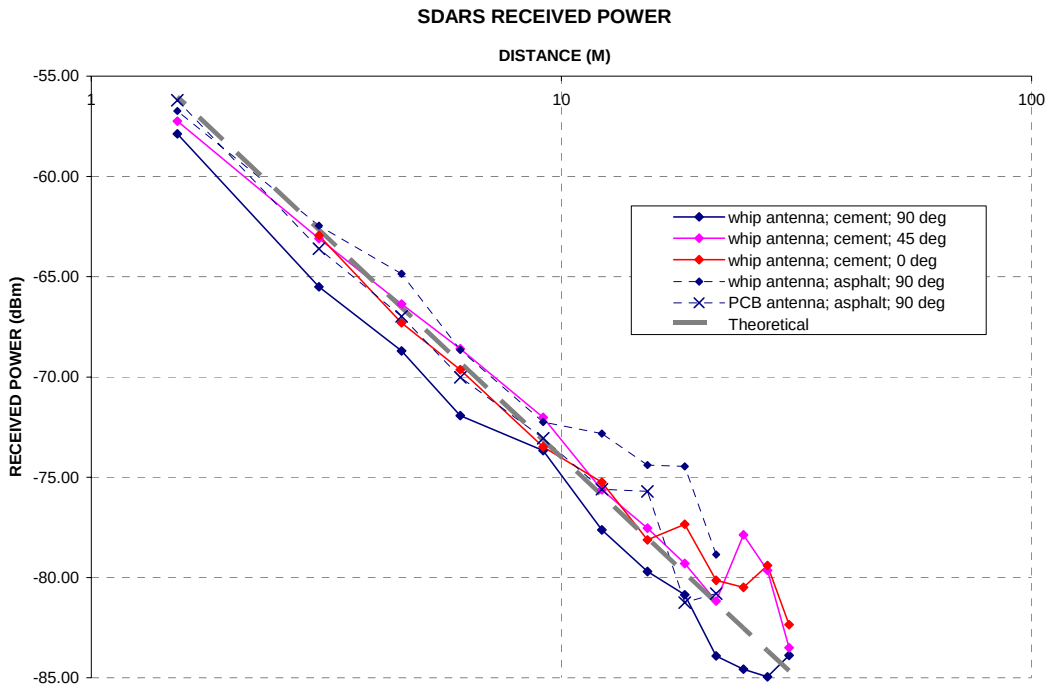


Figure 1: NextWave WCS to SDARS CPE pathloss measurements

[3] *See* Comments of WCS Coalition, WT Docket No. 07-293, at Attachment B (filed Feb. 14, 2008)("*WCS Coalition Comments*").)

[4] The results of the ATECS testing are being filed with the reply comments of the WCS Coalition to which this white paper is annexed.

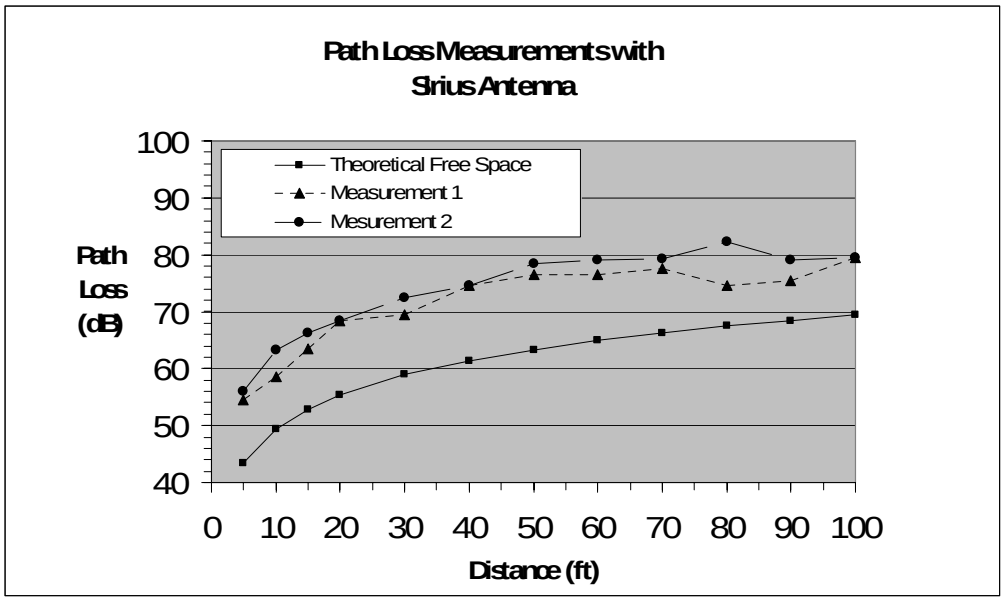


Figure 2: Coalition Pathloss testing results

	Path Loss Near Field Range (5 to 50 ft)	Path Loss Far Field Range (5 to 100 ft)
Measurement 1	**49.3 + 22.6 LogD**	**51.7 + 18.7 LogD**
Measurement 2	**52.5 + 21.1 LogD**	**53.8 + 19.1 LogD**
Aggregate	50.9 + 21.8 LogD	52.7 + 18.9 LogD
Theoretical Free Space	40 + 20 LogD	40 + 20 LogD

Table 1: Result of Coalition Pathloss Testing with D in meters

Noise Floor Discussion

XM and Sirius both claim that the SDARS receiver noise floor is accurately represented by the noise measurements made by Florida Atlantic University R&D Lab ("FAU"),[5] The SDARS receiver noise floor is claimed to be -113.25 dBm/4 MHz.

[5] *See Sirius Comments*, Ex. C, Appendix at 2-6; *XM Comments*, Ex. C at 10-15.

Typically, the baseline receiver noise power for terrestrial two-way services is given by the equation P = kTB [6], which resolves to -174 dBm/Hz + 10*log (BW), where

P = noise power in watts
K = Boltzmann's constant (1.38 x 10^{-23} joules/Kelvin)
T = 290 degree Kelvin (equivalent to 62 degrees F)
BW = the effective receiver bandwidth in Hertz

For a 4 MHz bandwidth receiver, the calculated noise floor is therefore:

-174 dBm/Hz + 66 + NF = -108 dBm/4 MHz + NF

NF = receiver or LNA noise figure in dB

With a commercial Low Noise Amplifier ("LNA") noise figure on the order of 1.2 dB[7], the theoretical noise figure of a typical SDARS receiver would be:

(1) -108 dBm/4 MHz + 1.2 dB = -106.8 dBm/4 MHz

which is 6 dB greater than the FAU results.

In order to accept the XM and Sirius results as accurate, one must conclude that their receivers are operating with an effective noise temperature and resulting noise power that is much lower than the assumed 290 degrees K-based value. While it is not unusual for a lower noise temperature than 290 K to be realized when a high gain antenna is pointed at the dark sky, such as when communicating with deep space probes, the wide beamwidth antennas used by Sirius and XM hardly qualify for such consideration since their side lobes have visibility to the earth and man made noise sources. The wide beamwidth antennas capture noise from man made sources, such as Wi-Fi access points, automotive ignition noise and other sources, as well as earth-related thermal noise which is closer to the typical 290 degrees K (62 degrees F). References in the technical literature point to man made urban noise rise at 2.3 GHz being approximately 10 dB greater than theoretical KTB noise at T = 290 degrees Kelvin.[8] This leads to the more realistic conclusion that the actual SDARS noise floor in a populated urban area would be on the order of -106.8 dBm/4 MHz + 10 dB, based on (1) above, resulting in an actual receiver noise floor of:

(2) Urban SDARS noise floor = -106.8 dBm + 10 dB = -96.8 dBm/4 MHz.

.

The WCS Coalition has reviewed the measurements made by FAU and concludes that the measurements are in error. The likely sources of this error are improper spectrum

---

[6] Noise Temperature, Antenna Temperature and Sun Noise, Bob Atkins, The ARRL UHF/Microwave Experimenters Manual, 1990, page 7-58.
[7] From the specification sheet for Antenna Specialists model XM5013F.
[8] Reference Data for Engineers, Radio, Electronics, Computer and Communications, 8th Edition, Sams Publishing, page 34-37, figure 7.

analyzer setup and operation, out of date calibration, and/or improper interpretation of the spectrum analyzer readings. It also appears that the gain figures stated for the Sirius and XM antennas are suspiciously "round"[9] and are likely approximations, rather than actual measured values, as to the actual gain of these antennas. An accurate test would require that the gain of the LNA be measured and documented. It is also suspected that the measurements were likely made in a rural area, possibly at night, to portray the absolute best case scenario by reducing the outside noise input to the LNA.

NextWave Wireless Inc. has conducted measurements similar to those conducted by FAU and found much higher noise levels. NextWave's measurements of off-the-shelf Sirius and XM antenna/LNA modules were made with an Agilent ESA 4405B spectrum analyzer, using the noise marker function in 3 different locations and:

1. RF Shield Box
2. Rural area of San Diego as far on 67 Freeway south of Poway
3. Downtown San Diego

The measurement values were then adjusted for cable losses, bias tee insertion loss, LNA gain, etc. in the same manner as was documented by SDARS in the referenced documents.

The results of the NextWave testing for the Sirius antenna are shown below. The results of XM receiver testing are not shown due concerns that the module gain is below the expected value and therefore the noise measurement may be invalid. However, these measurements can be retaken and presented upon request by the FCC.

	RF Isolated	**Rural**	**Urban**
Sirius Antenna	-106.7 dBm/4MHz	**-106.2 dBm/4MHz**	**-96.4 dBm/4MHz**

Table 2: Measurement of Sirius LNA noise floor

These results conform to expectations, as opposed to the unrealistic -113 dBm/ 4 MHz value reported by SDARS. As calculated in equation (1) above, the baseline noise floor is consistent with the "RF Isolated" value in Table 2. The "Rural" value is only slightly higher than the shielded box measurement, as would be expected. The "Urban" measurement result is consistent with the real world noise floor rise expected from the technical literature and calculated as -96.8 dBm/4 MHz in (2) above.
.

Summary and Conclusions

In their analysis, XM and Sirius have not accurately portrayed the pathloss between two mobile CPE in close proximity and have incorrectly measured their receiver noise floor. The first error results in a 9.2 dB adjustment, while the 2nd error results in a 6 to 16 dB adjustment, depending on the expected environment the receiver is operating in.

[9] *See XM Comments*, Ex. C at 14 (stating ALNA gain is "22 dB"); *Sirius Comments*, Ex. C, Appendix 1 at 5 (stating ALNA gain is "25 dB").

The WCS Coalition believes that the most accurate way to assess the effect of a proposed WCS mobile CPE mask is to conduct actual field measurements, instead of making worst-case assumptions and leaving out relevant information, such as duty cycle and the effects of transmit power control.

ATTACHMENT B

WCS Test Report

WCS Impact Testing with XM and Sirius radios

March 17, 2008

Version 6.1

Prepared by:

15042 Prairie Place
Broomfield, CO 80020
303-550-6413
www.atecs.biz

Table of Contents

1.0 EXECUTIVE SUMMARY 3

2.0 TEST METHODOLOGY 5
2.1 WCS frequency bands 5
2.2 Test Locations 6

3.0 TEST EQUIPMENT 9
3.1 SDARS 9
3.2 WiMAX Emulation 11

4.0 TEST CASES AND CONFIGURATION 12
4.1 Out-of-band emissions 12
4.1.1 Test Objective 12
4.1.2 Test Setup 12
4.2 Path Loss 14
4.2.1 Test Objective 14
4.2.2 Test Setup 14

5.0 RESULTS 16
5.1 RF Survey 16
5.2 Out-of-band emissions 19
5.3 Path Loss 20

6.0 CONCLUSIONS 27

1.0 EXECUTIVE SUMMARY

Field testing was performed to determine the impact of Wireless Communication Service (WCS) WiMAX Customer Premise Equipment (CPE) upon SDARS (Satellite Digital Audio Radio Service) receivers. Two field test cases were conducted, namely (1) out-of-band emissions (OOBE) impact to SDARS receivers and (2) path loss measurements at WCS C and D blocks.

The OOBE test investigated the effect a 'stepped' waveform across the SDARS band from 2320 MHz to 2345 MHz would have on Sirius and XM receivers in satellite-only coverage at 6% and 43% duty cycles. The waveform is depicted in Figure 1.0 below.

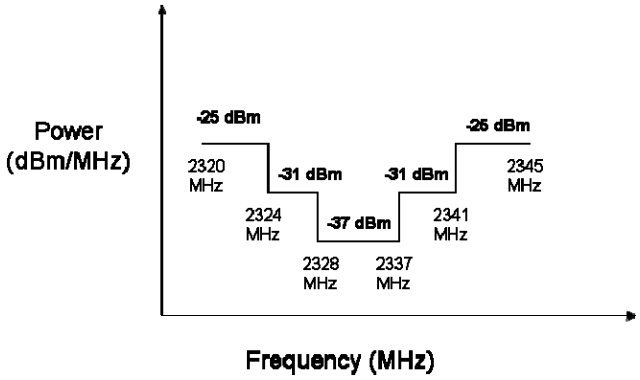


Figure 1.0 Graph of stepped power levels per frequency that forms out-of-band emission

Testing was performed at a location in the Washington, District of Columbia (DC) metro area under Special Temporary Authority (STA). Three XM (Inno, Skyfi2, and Original Equipment Manufacturer or OEM) and three Sirius radios (Sportster5, ST1, and OEM) were tested.

As shown in Table 1.1, performance variations across the three Sirius and three XM radios were observed when measuring audio muting distances in out-of-band emission conditions. No audio muting occurred for three of the six radios at 6% duty cycle.

OOBE 'STEPPED MASK' TEST (satellite-only)	XM (+)				SIRIUS (+)		
	Distance to Mute (ft)				Distance to Mute (ft)		
DUTY CYCLE	Inno	Skyfi2	XM OEM		Sportster 5	ST1	Sirius OEM
6%	no muting	6	8		no muting	3	no muting
43%	18	20	24		8	7	21

Table 1.1 Out-of-band emissions test results for XM and Sirius radios in satellite-only coverage

All field testing was performed using active SDARS (XM and Sirius) antennas mounted on the roof of a vehicle. All testing was conducted with the SDARS antennas in the same horizontal plane and height as the antenna used to transmit the OOBE signal.

Path Loss measurements were conducted using Sirius and XM antennas at a location also in the Washington, District of Columbia (DC) metro area under Special Temporary Authority (STA). Two types of measurement methods were used with a Sirius Sportster5 antenna. The first used a 30 kHz CW tone and the second used a continuous WiMAX 5 MHz waveform at a center frequency of 2317.5 MHz (WCS C block). The measurement method with a XM Delphi antenna used a continuous WiMAX 5 MHz waveform at a center frequency of 2347.5 MHz (WCS D block).

Curve fit analysis results in the near field (5 to 50 feet) and far field (5 to 100 feet) range at WCS C and D blocks are shown in Tables 1.2 and 1.3 and show good correlation between measurements. Note that field measurements were taken in feet and converted to meters so Path Loss equations could be produced in meters for comparison to historical WCS coalition data. The tables also provide a comparison to theoretical free space.

	Path Loss Near Field Range (5 to 50 ft)	**Path Loss Far Field Range (5 to 100 ft)**
Measurement 1	49.3 + 22.6 LogD	51.7 + 18.7 LogD
Measurement 2	52.5 + 21.1 LogD	53.8 + 19.1 LogD
Aggregate	**50.9 + 21.8 LogD**	**52.7 + 18.9 LogD**
Theoretical Free Space	**40 + 20 LogD**	**40 + 20 LogD**

Table 1.2 Curve fit path loss with Sirius antenna (D in meters) in WCS C block

	Path Loss Near Field Range (5 to 50 ft)	**Path Loss Far Field Range (5 to 100 ft)**
Measurement	50.3 + 20.9 LogD	52.7 + 17.2 LogD
Theoretical Free Space	40 + 20 LogD	40 + 20 LogD

Table 1.3 Curve fit path loss with XM antenna (D in meters) in WCS D block

2.0 TEST METHODOLOGY

The field test used off-the-shelf SDARS CPE's from XM and Sirius and an Agilent ESG Waveform Generator to simulate 'white noise' out-of-band emission. Off-the-shelf equipment was used to create "real world" conditions to determine a distance between active SDARS antennas and stepped waveform OOBE across the SDARS band at which muting consistently occurs.

Field test locations were selected where SDARS network service was offered in satellite-only and satellite-terrestrial overlap coverage per Special Temporary Authority (STA) provided by the Federal Communications Commission (FCC).

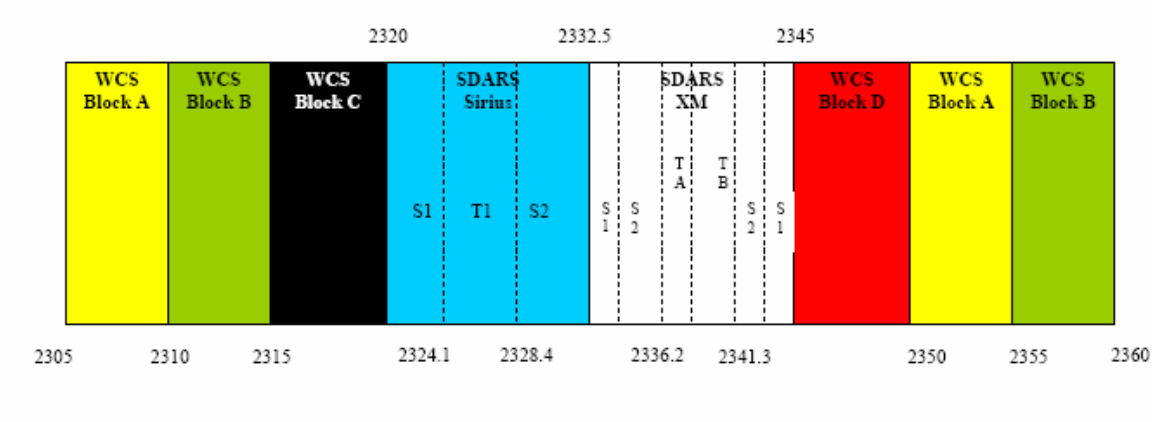
Field tests were conducted in out-of-vehicle scenarios. Out-of-vehicle tests consisted of the SDARS antennas positioned on the roof of the test vehicle and the antenna used to transmit the OOBE in the same horizontal plane and height as the SDARS antennas.

Path Loss measurements were conducted in the WCS C and D block using 30 kHz and 5 MHz bandwidth signals and SDARS antennas to compare with theoretical free space path loss.

2.1 WCS frequency bands

SDARS and WCS services are in adjacent frequency bands as shown in the tables below per FCC spectrum allocation.

Service	Frequency (MHz)
WCS A Lower	2305 to 2310
WCS B Lower	2310 to 2315
WCS C	2315 to 2320
SDARS Sirius	2320 to 2332.5
SDARS XM	2332.5 to 2345
WCS D	2345 to 2350
WCS A Upper	2350 to 2355
WCS B Upper	2355 to 2360



2.2 Test Locations

The following two locations were used to conduct the field tests under FCC granted STA each representing SDARS network coverage test conditions.

1) 150 Henze Lane, Castleton, VA (38 38 5 North; 78 7 28 West)

The Castleton, VA field test location was at a private residence in the foothills of the Shenandoah Mountains and provided satellite-only coverage for XM and Sirius networks. The test area was a flat open field surrounded by no foliage and coniferous trees and some buildings as shown in Figure 2.2.1. Figures 2.2.2 and 2.2.3 show full bars for satellite and no bars for terrestrial coverage on XM and Sirius radios.

Figure 2.2.1 Castleton, VA field test location

Figure 2.2.2 XM Skyfi1 depicting 6 full bars for satellite-only coverage at Castleton, VA location

Figure 2.2.3 Sirius Sportster5 depicting 10 full bars for satellite-only coverage at Castleton, VA location

2) 4603 Green Springs Rd, Lincolnia, VA (38 49 27 North; 77 9 27 West)

The Lincolnia, VA field test location was at a parking lot at Green Springs Garden (a Fairfax County Park) and provided satellite-terrestrial repeater overlap coverage for the Sirius network. The parking lot was a flat open space surrounded by no foliage trees close by on one side as shown in Figure 2.2.4. Figure 2.2.5 show full bars for satellite and terrestrial coverage on the Sirius radio.

Figure 2.2.4 Sirius satellite-terrestrial network coverage

Figure 2.2.5 Sirius Starmate (ST1) depicting 10 full bars for satellite and terrestrial coverage at Lincolnia, VA location

3.0 TEST EQUIPMENT

This section provides a list and discussion of the test equipment used for the field test.

3.1 SDARS

The SDARS radios listed in Table 3.1.1 were used during the test.

VENDOR	MODEL	SERIAL NUMBER	DESCRIPTION
XM	Inno	LC: 31375-202	newly purchased at Best Buy Mar 3 2008
XM	Skyfi2	LC 0126-0317 Delphi Sa10101	
XM	Original Equipment Manufacturer (OEM)	N/A	2008 Suturn Outlook XE (Alamo rental car)
Sirius	Sportster 5	SID: 023428357177	newly purchased at Circuit City Feb 11 2008
Sirius	Sportster 5	SID: 023428428012	newly purchased at Circuit City Mar 3 2008
Sirius	Starmate 1	SID: 017210261902	
Sirius	Original Equipment Manufacturer (OEM)	N/A	2008 Ford Explorer (Hertz rental car)

Table 3.1.1 List of SDARS radios used for test

The following three Sirius radios were used: Sportster5, Starmate (ST1), and Original Equipment Manufacturer (OEM) as shown in Figures 3.1.1 to 3.1.4. The Sportster5 radio was purchased new one day before the field tests began. The Sirius OEM 2008 Ford Explorer was rented from Hertz one day before the field test began.

Figure 3.1.1 Sirius Sportster 5

Figure 3.1.2 Sirius Starmate 1 (ST1)

Figure 3.1.3 Sirius OEM (2008 Ford Explorer - Hertz)

Figure 3.1.4 Sirius OEM antenna (right) and Sirius Sportster 5 magnetic mount antenna (left)

The following three XM radios were used: Inno, Skyfi2, Inno, and Original Equipment Manufacturer (OEM) as shown in Figures 3.1.5 to 3.1.8. The Inno radio was purchased new one day before the field tests began. The XM OEM 2008 Saturn Outlook XE was rented from Alamo one day before the field tests began.

Figure 3.1.5 XM Inno

Figure 3.1.6 XM SkyFi2

Figure 3.1.7 OEM (2008 Saturn Outlook XE – Alamo)

Figure 3.1.8 OEM antenna (left) and XM Delphi magnetic mount antenna (right)

3.2 WiMAX Emulation

Table 3.2 provides a list of all equipment used to emulate WiMAX CPE.

Test Equipment	Vendor	Model Number	Description	Serial Number
Agilent 4438C	Agilent	E4438C	ESG Vector Signal Generator	10010193
Spectrum analyzer	Adventest	U3741 Spectrum Analyzer	9kHz to 8 GHz	n/a
Wimax Antenna	Johanson Technology	P/N 2500AT44M0400	Wimax 2.3 - 2.7 GHz chip antenna	n/a
RF antenna	Hyperlink Technologies	HG26090	RF antenna	n/a
Magnetic Mount Base	Diamond Antennas	DPK-4NM-N	mag mount for RF antenna	n/a
Bias Tee	Mini-Circuits	ZX85-12G-S	0.2 to 12000 MHz	n/a

Table 3.2 WiMAX emulation equipment

4.0 TEST CASES AND CONFIGURATION

This section describes the test objective and test setup used during the field tests.

4.1 Out-of-band emissions

4.1.1 Test Objective

The objective of this field test was to measure the audio impairment to SDARS receivers while transmitting out-of-band emissions across the entire 25 MHz SDARS band. This field test measured the audio muting distance to SDARS subscriber equipment while generating a 'white noise' waveform at 'stepped' power levels across the entire SDARS band (2320 to 2345 MHz) using 6% and 43% duty cycles, as shown in Figure 4.1.1. Table 4.1.1 also shows the out-of-band emission level per frequency 'step'. Tests were conducted in SDARS satellite-only coverage.

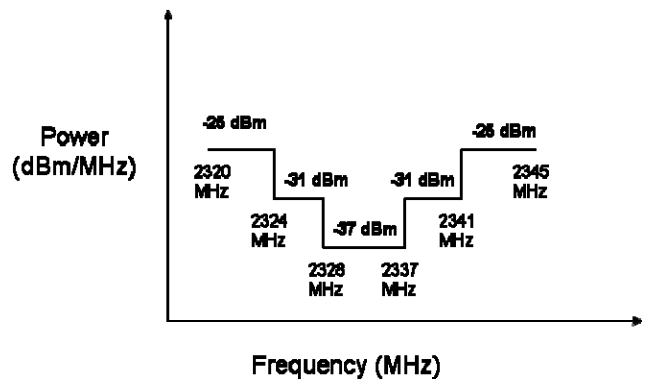


Figure 4.1.1 Graph of 'stepped' power levels per frequency

Frequency (MHz)	Out-of-band emission Level (dBm/MHz)
2320 to 2324	-25
2324 to 2328	-31
2328 to 2337	-37
2337 to 2341	-31
2341 to 2345	-25

Table 4.1.1 Table of 'stepped' power levels per frequency

4.1.2 Test Setup

An Agilent E4438 ESG vector signal generator was used to generate 'white noise' at stepped power levels across the entire SDARS band. A cart was used to mount a WiMAX antenna and measure distance to mute using LMR-400 antenna cable connected the signal generator as shown in Figures 4.1.2 and 4.1.3.

A vehicle was used to mount the SDARS antenna/LNA fixture as a direct install (OEM) or with a magnetic mount (purchased off-the-shelf). In all cases, the SDARS antenna and WiMAX antenna were configured at equal heights of 5 feet (1.5 m) to maintain position in the same horizontal plane. The SDARS radios listed

in section 3 were used during the test. During field tests, Sirius always received on channel 184 and XM always received on channel 1.

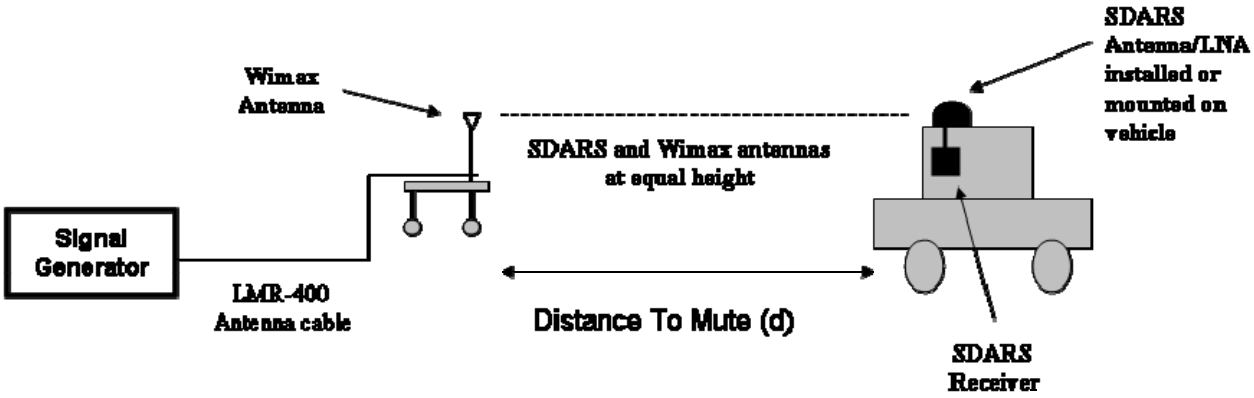


Figure 4.1.2 OOBE Test Configuration

The 'stepped' power waveform was calibrated at each frequency step using an Adventest U3741 Spectrum Analyzer with the power adjusted to compensate for the antenna cable loss as shown in Figure 4.1.4.

Figure 4.1.3 OOBE Test Configuration

Figure 4.1.4 OOBE Test Calibration Setup

Figures 4.1.5 and 4.1.6 show the actual 'stepped' power waveform for 43% duty cycle calibrated for -25 dBm/MHz at 2345 MHz and 2320 MHz for XM and Sirius radio tests respectively. Similar waveforms were calibrated for 6% duty cycles.

The Sirius and XM magnetic mount antennas (i.e. Sportster5, ST1, Inno and Skyfi2) were positioned in the same plane as the OEM installed antenna 12 inches apart and approximately 18 inches from the vehicle edge (reference Figure 3.1.4 and 3.1.8).

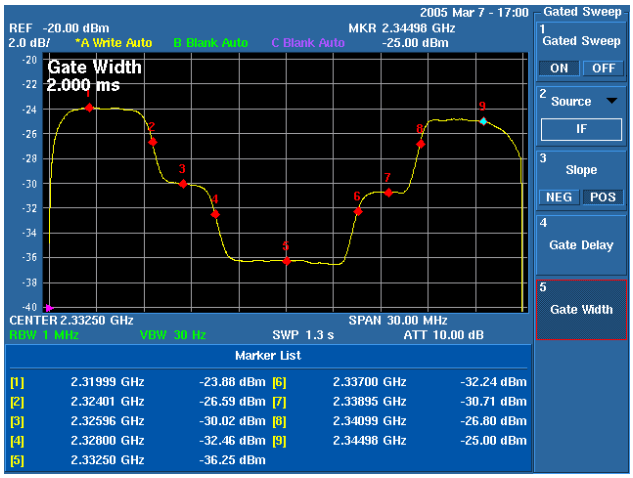


Figure 4.1.4 OOBE Test Calibration for XM radios

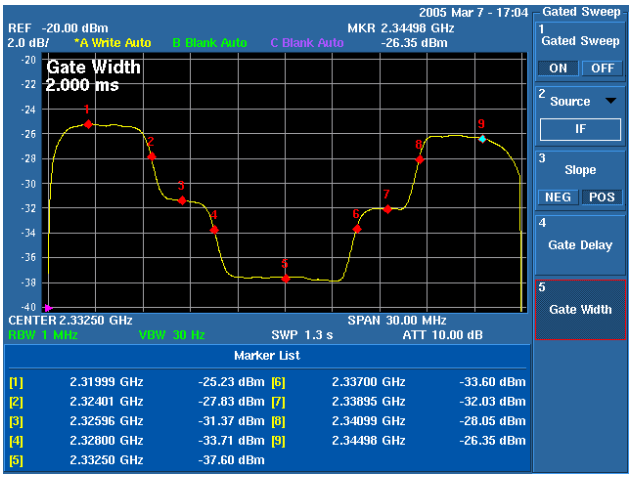


Figure 4.1.5 OOBE Test Calibration for Sirius radios

4.2 Path Loss

4.2.1 Test Objective

This field test measured the path loss at 2317.5 MHz (WCS C block) and 2347.5 MHz (WCS D block) using a 30 kHz CW tone and a continuous WiMAX 5 MHz waveform through a WiMAX antenna and various SDARS antenna/LNA's at the receiver.

4.2.2 Test Setup

An Adventest U3751 Spectrum Analyzer was used to generate a 30 kHz CW tone into a WiMAX antenna and to measure the receive signal strength from an active SDARS antenna/LNA power and a bias-tee. A second test method used an Agilent 4438C to generate a continuous WiMAX 5 MHz waveform as a signal source. The test configuration is shown in Figure 4.3.1 and 4.3.2. A Spectrum Analyzer was used to calibrate the 30 kHz CW tone and continuous WiMAX 5 MHz waveform to compensate for antenna cable loss.

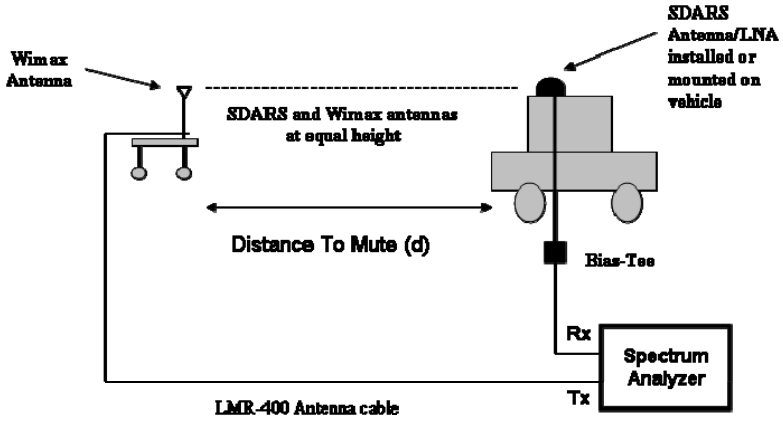


Figure 4.3.1 Coupling Loss Configuration

Test permutations consisted of measurements at the WCS C and D blocks center frequency using Sirius Sportster5 and XM Inno antennas, respectively.

Figure 4.3.2 Path Loss Configuration

5.0 RESULTS

This section presents the results, analysis, and data of the field test.

5.1 RF Survey

RF surveys were conducted using the Adventest U3751 Spectrum Analyzer, SDARS antennas, bias tee, and an RF antenna to measure the received signal strength in the XM and Sirius satellite and terrestrial bands at each field test location. Additional RF surveys were conducted to scan adjacent bands for interference.

XM and Sirius satellite-only coverage

The field test location for XM and Sirius satellite-only coverage was Castleton, VA (38-39-05 N, 78-07-28 W). The channel power in the upper XM satellite band (2341.3 to 2345 MHz) was measured at -67.1 dBm with a XM Delphi antenna/LNA, bias tee, and spectrum analyzer, shown in Figure 5.1.1.

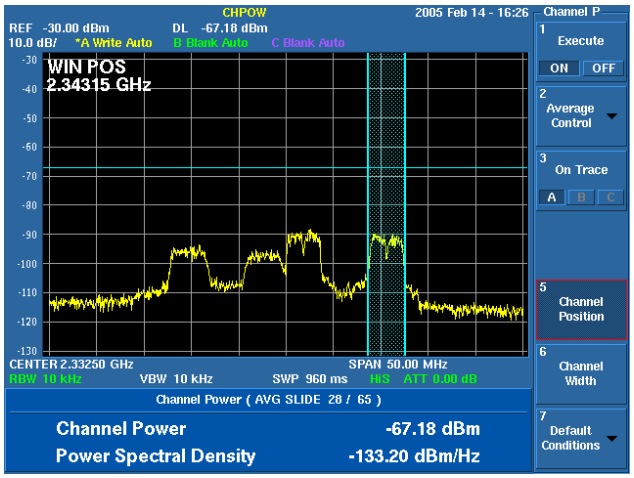


Figure 5.1.1 Channel Power in upper XM satellite band

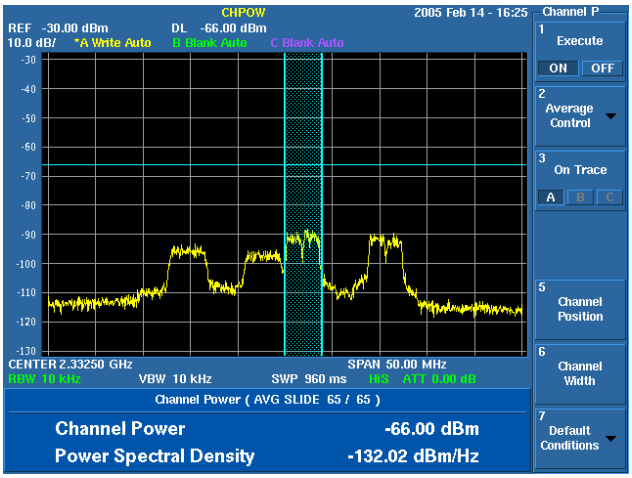


Figure 5.1.2 Channel Power in lower XM satellite band

The channel power in the lower XM satellite band (2332.5 to 2336.2 MHz) was measured at -66 dBm with a XM Delphi antenna, bias tee, and spectrum analyzer, shown in Figure 5.1.2.

The channel power in the lower Sirius satellite band (2320 to 2324.2 MHz) was measured at -66.7 dBm with a Sirius Sportster5 antenna/LNA, bias tee, and spectrum analyzer, shown in Figure 5.1.3.

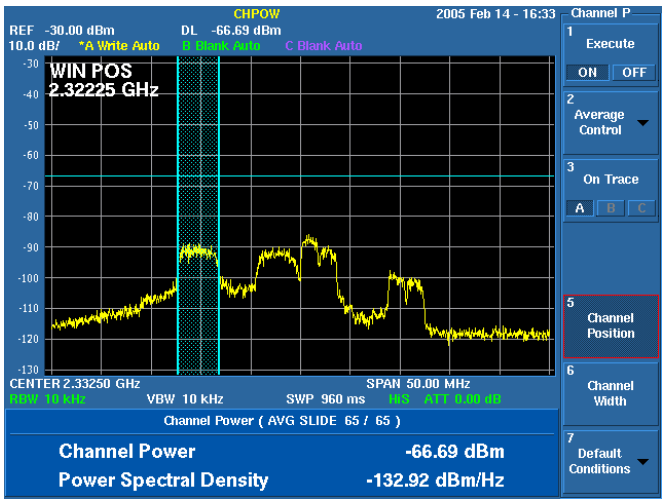


Figure 5.1.3 Channel Power in lower Sirius satellite band

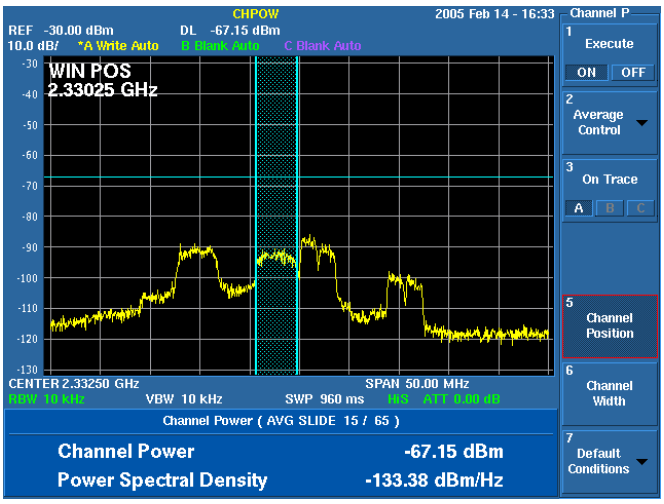


Figure 5.1.4 Channel Power in upper Sirius satellite band

The channel power in the upper Sirius satellite band (2328.3 to 2332.5 MHz) was measured at -67.2 dBm with a Sirius Sportster5 antenna, bias tee, and spectrum analyzer, shown in Figure 5.1.4.

A measurement taken with a WiMAX antenna with spectrum analyzer +/- 500 MHz from the center of the SDARS band shows no sources of interference, shown in Figure 5.1.5.

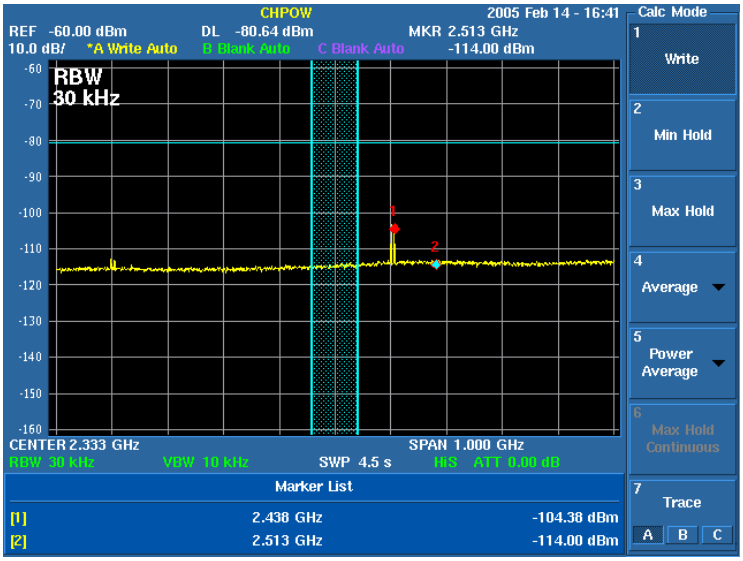


Figure 5.1.5 Interference measurement from 1833 to 2833 MHz

Sirius satellite-terrestrial network coverage

The field test location for Sirius satellite-terrestrial network coverage was Lincolnia, VA (38-49-27 N, 77-9-27 W). The channel power in the Sirius terrestrial repeater band (2324 to 2328 MHz) was measured at -78.0 dBm with a WiMAX antenna with spectrum analyzer, shown in Figure 5.1.6.

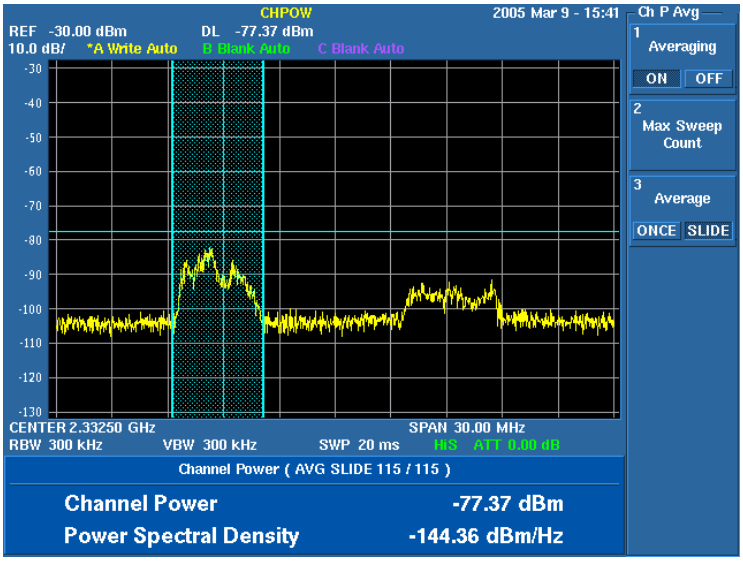


Figure 5.1.6 Channel Power in Sirius terrestrial repeater band

5.2 Out-of-band emissions

The out-of-band emissions field test was conducted at the XM and Sirius satellite-only network coverage at the Castleton, VA test location as shown in Figures 5.2.1 and 5.2.2. As described in section 4, a 'white noise' waveform at stepped power levels was generated across the entire SDARS band at 6% and 43% duty cycles.

Figure 5.2.1 OOBE test in Castleton, VA (XM radio)

Figure 5.2.2 OOBE test in Castleton, VA (Sirius radio)

The method used to determine audio muting consisted of starting measurements in an audio muted state with the WCS antenna at distance of 3 feet from the SDARS antenna/LNA mounted on the vehicle roof at the same antenna height and horizontal plane. 3 feet was the closest distance to the SDARS antenna/LNA due to physical constraints of the vehicle. The vehicles were situated so the SDARS antenna/LNA was positioned closest to the edge of the rooftop with no obstructions (i.e. roof rack) in the direction of the WCS antenna. Measurements were then continued in 1 foot increments <u>away</u> from the vehicle until 15 consecutive seconds of audio were heard with no interruption. Once 15 consecutive seconds of uninterrupted audio was confirmed, measurements were continued in 1 foot increments <u>toward</u> the vehicle until audio muting was repeated. Once an audio interruption was confirmed, measurement was continued <u>away</u> from the vehicle until 15 consecutive seconds of uninterrupted audio was confirmed. The furthest location of repeatable interrupted audio was then recorded as the distance to mute.

Results of the out-of-band emissions test for satellite-only network coverage is shown in Table 5.2.1. No muting indicates that no audio muting occurred at a distance of less than 3 feet.

OOBE 'STEPPED MASK' TEST (satellite-only)	XM				SIRIUS		
	Distance to Mute (ft)				Distance to Mute (ft)		
DUTY CYCLE	Inno	Skyfi2	XM OEM		Sportster 5	ST1	Sirius OEM
6%	no muting	6	8		no muting	3	no muting
43%	18	20	24		8	7	21

Table 5.2.1 Out-of-band emissions test results for XM and Sirius radios in satellite-only coverage

The XM Inno (LC: 31375-202), Sirius Sportster5 (SID: 023428428012) and the SDARS equipment listed in Table 3.1.1 were used for this field test.

5.3 Path Loss

A path loss test was conducted using an XM and Sirius antenna. Two test measurement methods were used. The first method used an Adventest U3741 spectrum analyzer as the transmit source to generate a 30 kHz CW tone. The second method used an Agilent 4438C continuous WiMAX 5 MHz waveform as the transmit source. Both methods used the Adventest U3741 spectrum analyzer to measure the received signal.

A Sportster5 antenna (silver emblem) model SIR-3.3RCTMOB05 was used for the path loss measurements with the Sirius antenna.

The first method of measurement (Measurement 1) used the Adventest U3741 spectrum analyzer to generate a 0 dBm 30 kHz CW tone at the output of a 120 ft LMR-400 antenna cable and into a 0.5 dBi WCS antenna. The transmit EIRP was 0.5 dBm. A Sirius Sportster5 antenna was used with a bias tee through an antenna jumper to the Adventest U3741 spectrum analyzer to measure the received signal. A correction factor of 25.5 dB was used to correct the receive signal for LNA gain/antenna cable (27 dB), bias tee insertion loss/jumper cable loss (-1 dB), Sirius antenna gain (-1 dBi), and WCS antenna gain (0.5 dBi) and produce the path loss.

The second method of measurement (Measurement 2) used the Agilent 4438C to generate a 0 dBm continuous WiMAX 5 MHz waveform at the output of a 120 ft LMR-400 antenna cable and into a 0.5 dBi WCS antenna. The transmit EIRP was 0.5 dBm. A Sirius Sportster5 antenna was used with a bias tee through an antenna jumper to the Adventest U3741 spectrum analyzer to measure the received signal. The same 25.5 dB correction factor was used to correct the receive signal to produce the path loss.

A center frequency of 2317.5 MHz (center of C band) was used for both measurements. Measurements were then taken at 5 ft increments to 20 ft, then 10 ft increments to 100 ft. Results of both methods are shown in table 5.3.1.

Sirius Sportster 5 antenna (SIR-3.3 RCTMOB05) Path Loss Measurements				
Distance (ft)	Distance (m)	Theoretical Free Space Path Loss (dB)	Path Loss Measurement 1 (dB)	Path Loss Measurement 2 (dB)
5	1.5	43.4	54.5	56.1
10	3.0	49.4	58.5	63.3
15	4.6	52.9	63.5	66.3
20	6.1	55.4	68.5	68.5
30	9.1	58.9	69.5	72.5
40	12.2	61.4	74.5	74.6
50	15.2	63.4	76.5	78.5
60	18.3	65.0	76.5	79
70	21.3	66.3	77.5	79.2
80	24.4	67.5	74.5	82.2
90	27.4	68.5	75.5	79
100	30.5	69.4	79.5	79.5

Table 5.3.1 Path Loss measurements using Sirius Sportster5 antenna

Results of measurement 1 and measurement 2 compared to theoretical free space are shown in Figure 5.3.1. Results show good correlation between measurements 1 and 2.

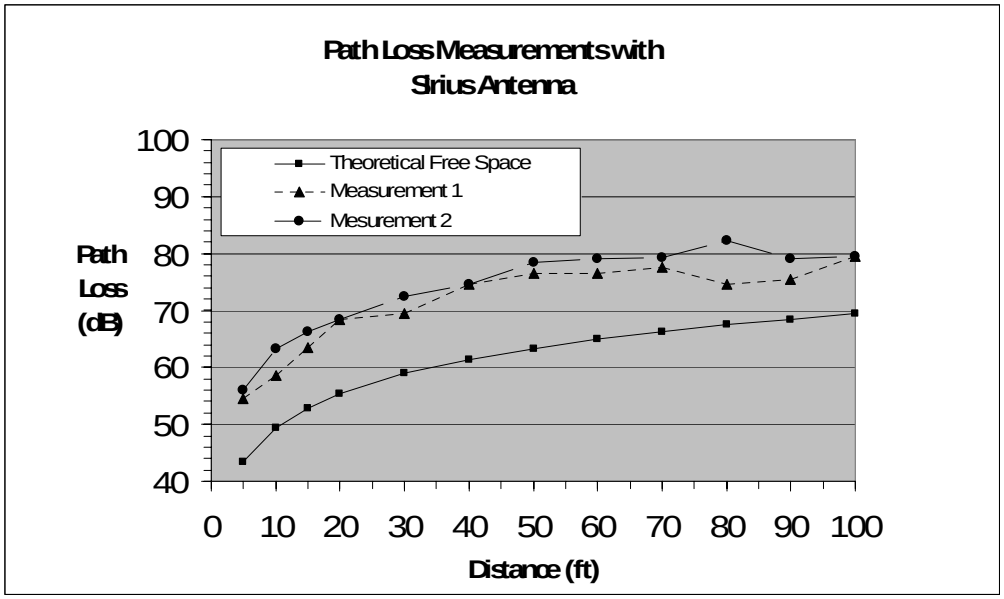


Figure 5.3.1 Path Loss measurements with Sirius antenna

A curve fit analysis of each measurement was conducted at a 'near field' range of 5 ft to 50 ft (1.5 to 15.2 m) and at a 'far field' range of 5 ft to 100 ft (1.5 to 30.5 m). The 'near field' range is a more representative path loss due to less influence from multipath and reflections experienced beyond 50 ft. Generating a path loss in this 'near field' range is also representative of the majority of audio muting distances measured during this field test. Table 5.3.2 provides results of curve fit analysis of Measurement 1, Measurement 2, Aggregate Measurement (of measurements 1 and 2) and Theoretical Free Space. Note that field measurements were taken in feet and converted to meters so Path Loss equations could be produced in meters for comparison to historical WCS coalition data. Path Loss plots are shown in Figures 5.3.1 to 5.3.4.

	Path Loss Near Field Range (5 to 50 ft)	**Path Loss Far Field Range (5 to 100 ft)**
Measurement 1	49.3 + 22.6 LogD	51.7 + 18.7 LogD
Measurement 2	52.5 + 21.1 LogD	53.8 + 19.1 LogD
Aggregate	**50.9 + 21.8 LogD**	**52.7 + 18.9 LogD**
Theoretical Free Space	**40 + 20 LogD**	**40 + 20 LogD**

Table 5.3.2 Curve Fit Path Loss measurements with Sirius antenna (D in meters)

The Sirius Sportster5 SID: 023428357177 was used for measurement 1 and SID: 023428428012 was used for measurement 2.

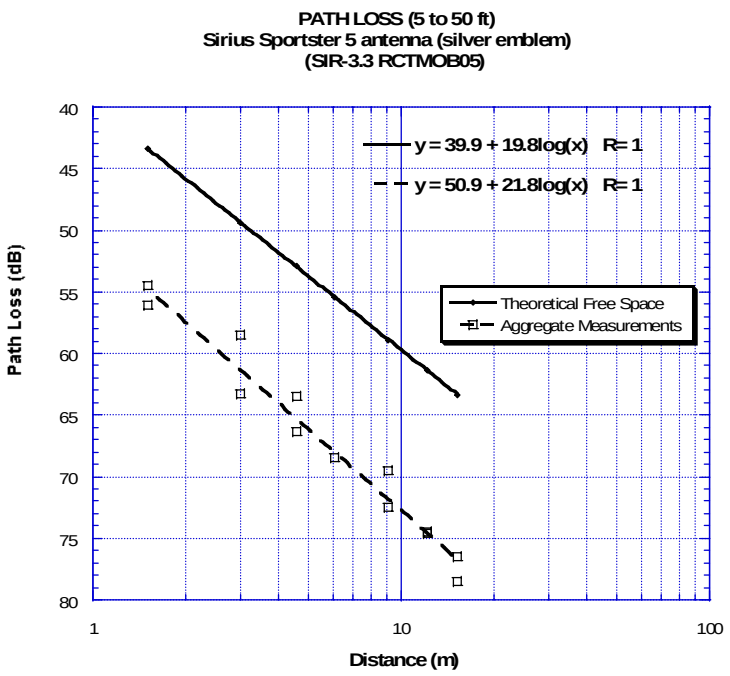


Figure 5.3.1 Near Field Range Path Loss of Aggregate and Theoretical Free Space

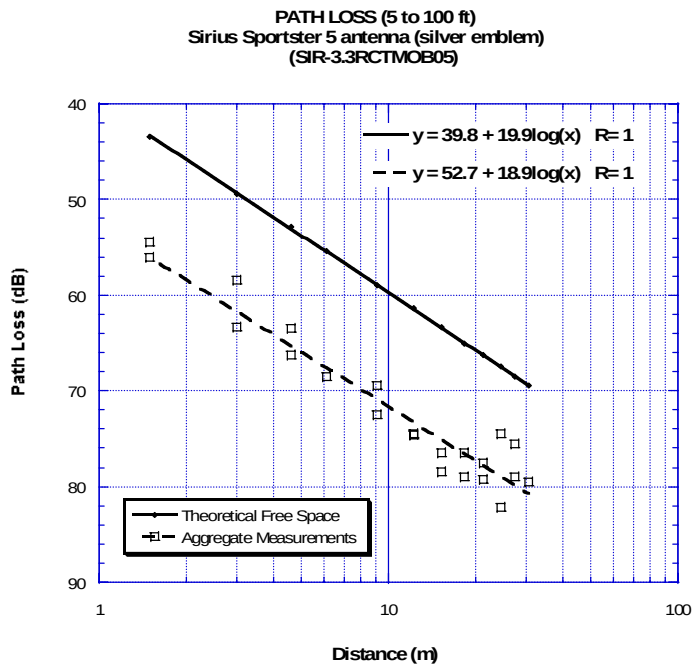


Figure 5.3.2 Far Field Range Path Loss of Aggregate and Theoretical Free Space

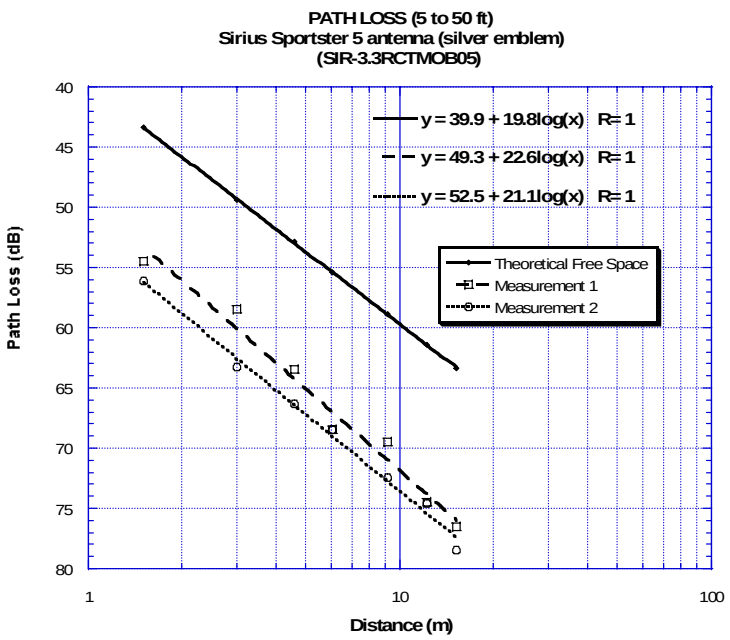


Figure 5.3.3 Near Field Range Path Loss of Measurements 1 and 2 with Theoretical Free Space

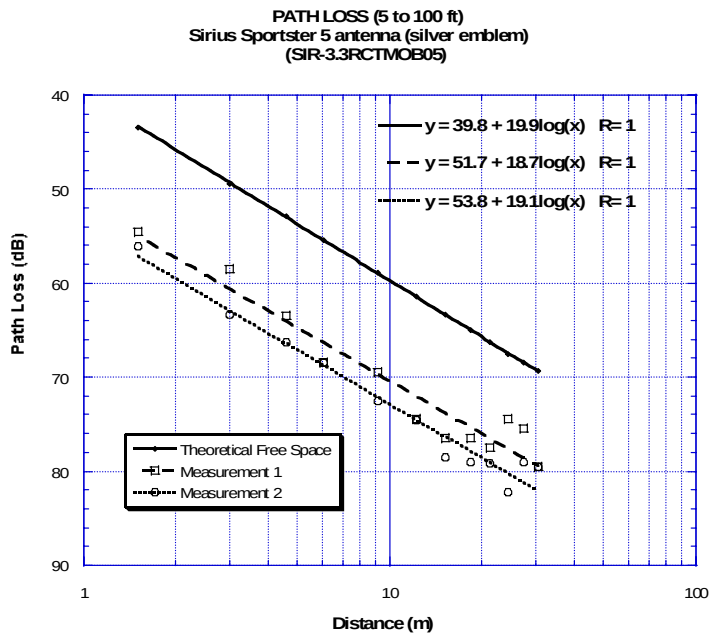


Figure 5.3.4 Far Field Range Path Loss of Measurements 1 and 2 with Theoretical Free Space

An Inno Delphi antenna was used for the path loss measurements with the XM antenna.

The method of measurement (Measurement 2) used the Agilent 4438C to generate a 0 dBm continuous WiMAX 5 MHz waveform at the output of a 120 ft LMR-400 antenna cable and into a 0.5 dBi WCS antenna. An XM antenna (# 620) was used with a bias tee through an antenna jumper to the Adventest U3741 spectrum analyzer to measure the received signal. A correction factor of 17.5 dB was used to correct the receive signal for LNA gain/antenna cable (19 dB), bias tee insertion loss/jumper cable loss (-1 dB), Sirius antenna gain (-1 dBi), and WCS antenna gain (0.5 dBi) and produce the path loss.

A center frequency of 2347.5 MHz (center of D band) was used for the measurement. Measurements were then taken at 5 ft increments to 20 ft, then 10 ft increments to 100 ft. Results are shown in table 5.3.3. Note that field measurements were taken in feet and converted to meters so Path Loss equations could be produced in meters for comparison to historical WCS coalition data. Results of measurement compared to theoretical free space are shown in Figure 5.3.5.

XM Antenna Path Loss Measurement			
Distance (ft)	**Distance (m)**	**Theoretical Free Space Path Loss (dB)**	**Path Loss Measurement (dB)**
5	1.5	43.4	53
10	3.0	49.4	59.5
15	4.6	52.9	64.7
20	6.1	55.4	69
30	9.1	58.9	72.5
40	12.2	61.4	72
50	15.2	63.4	72.9
60	18.3	65.0	75.1
70	21.3	66.3	80.2
80	24.4	67.5	80.3
90	27.4	68.5	71.6
100	30.5	69.4	72.9

Table 5.3.3 XM antenna Path Loss measurement

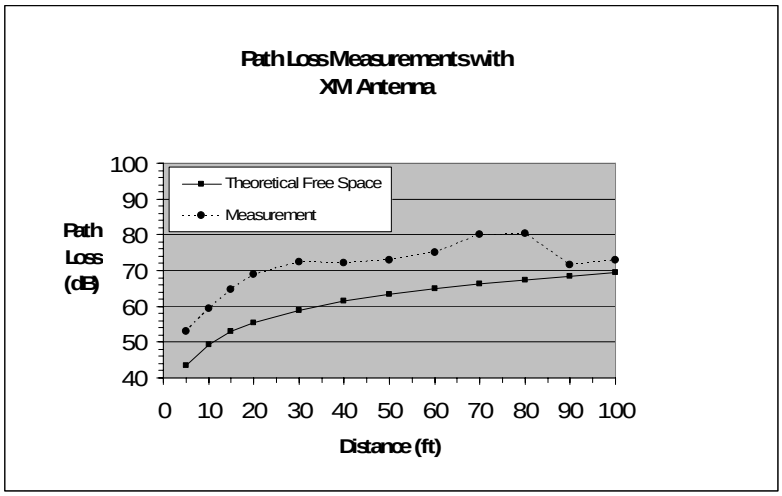
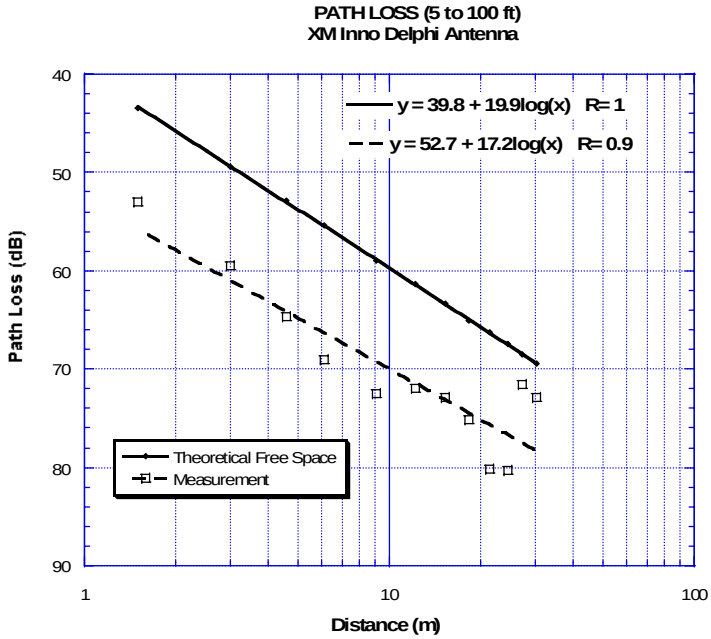


Figure 5.3.5 Path Loss measurements with XM antenna

A curve fit analysis of each measurement was conducted at a 'near field' range of 5 ft to 50 ft and at a 'far field' range of 5 ft to 100 ft. Table 5.3.4 provides results of curve fit analysis of the measurement and theoretical free space. Path Loss plots are shown in Figure 5.3.6.

	Path Loss Near Field Range (5 to 50 ft)	**Path Loss Far Field Range (5 to 100 ft)**
Measurement	50.3 + 20.9 LogD	52.7 + 17.2 LogD
Theoretical Free Space	40 + 20 LogD	40 + 20 LogD

Table 5.3.4 Curve Fit Path Loss measurements with XM antenna (D in meters)



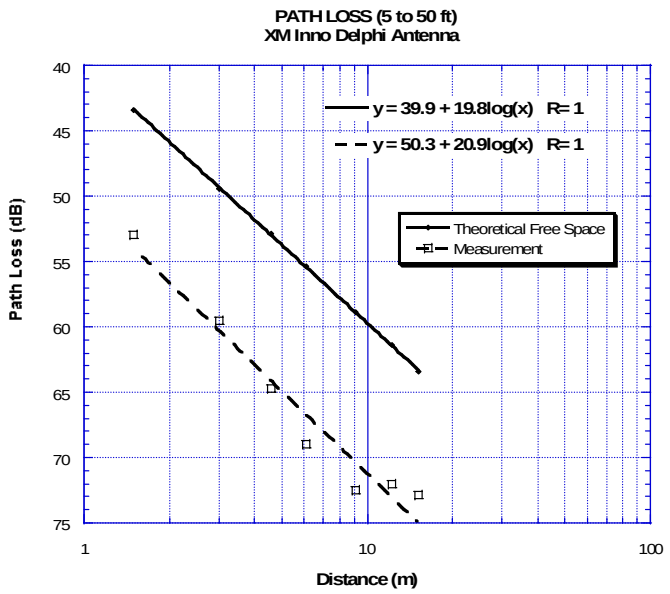


Figure 5.3.6 Near/Far Field Range Path Loss of XM Measurement and Theoretical Free Space

6.0 CONCLUSIONS

Out-of-band (OOBE) emissions tests were conducted using a stepped waveform across the SDARS 2320 to 2345 MHz band in satellite-only coverage for both XM and Sirius radios using 6% and 43% duty cycles. Three XM (Inno, Skyfi2, and OEM) and three Sirius radios (Sprortster5, ST1, and OEM) were tested.

As shown in section 5.2, performance variations across the family of Sirius and XM radios were observed when measuring muting distances in OOBE conditions. No audio muting occurred for three of the six radios at 6% duty cycle.

Path Loss measurements were conducted using Sirius and XM antennas. Two types of measurement methods were used with the Sirius antenna. The first used a 30 kHz CW tone and the second used a continuous WiMAX 5 MHz waveform at a center frequency of 2317.5 MHz (WCS C block). The measurement method with the XM antenna used a continuous WiMAX 5 MHz waveform at a center frequency of 2347.5 MHz (WCS D block).

As shown in section 5.3, results show good correlation between measurements. Curve fit analysis of near field range (5 to 50 feet) and far field range (5 to 100 feet) path loss for WCS C block are 50.9 + 21.8 Log D (meters) and 52.7 + 18.9 Log D (meters) respectively. Curve fit analysis of near field range (5 to 50 feet) and far field range (5 to 100 feet) path loss for WCS D block are 50.3 + 20.9 Log D (meters) and 52.7 + 17.7 Log D (meters), respectively. Note that field measurements were taken in feet and converted to meters so Path Loss equations could be produced in meters for comparison to historical WCS coalition data.

For further information contact:

Mark Poletti
Sr Partner
ATECS LLC
markpo@atecs.biz
303-550-6413
www.atecs.biz

ATTACHMENT C

The Effect of the Proposed WCS Mobile CPE Out-of-Band Emission Mask on SDARS Receiver Muting

Introduction

Field testing in February and March 2008 pursuant to special temporary authority granted the Wireless Communications Association International, Inc. investigated the effect that the WCS Coalition's proposed out-of-band emission (OOBE) mask for low-power WCS user devices would have on Sirius and XM receivers in satellite-only coverage areas. The test procedure and results are documented in the ATECS, LLC test report sections 4.1 and 5.2, respectively. The ATECS, LLC report is attached to the WCS Coalition Reply Comments.

The WCS Coalition proposed mask for WCS mobile customer premise equipment (CPE) consists of a stepped waveform across the SDARS band from 2320 MHz to 2345 MHz. This mask results in additional levels of protection to the SDARS diversity signals above what would be afforded by a flat OOBE mask. The proposed stepped reduction in WCS CPE OOBE levels is shown below:

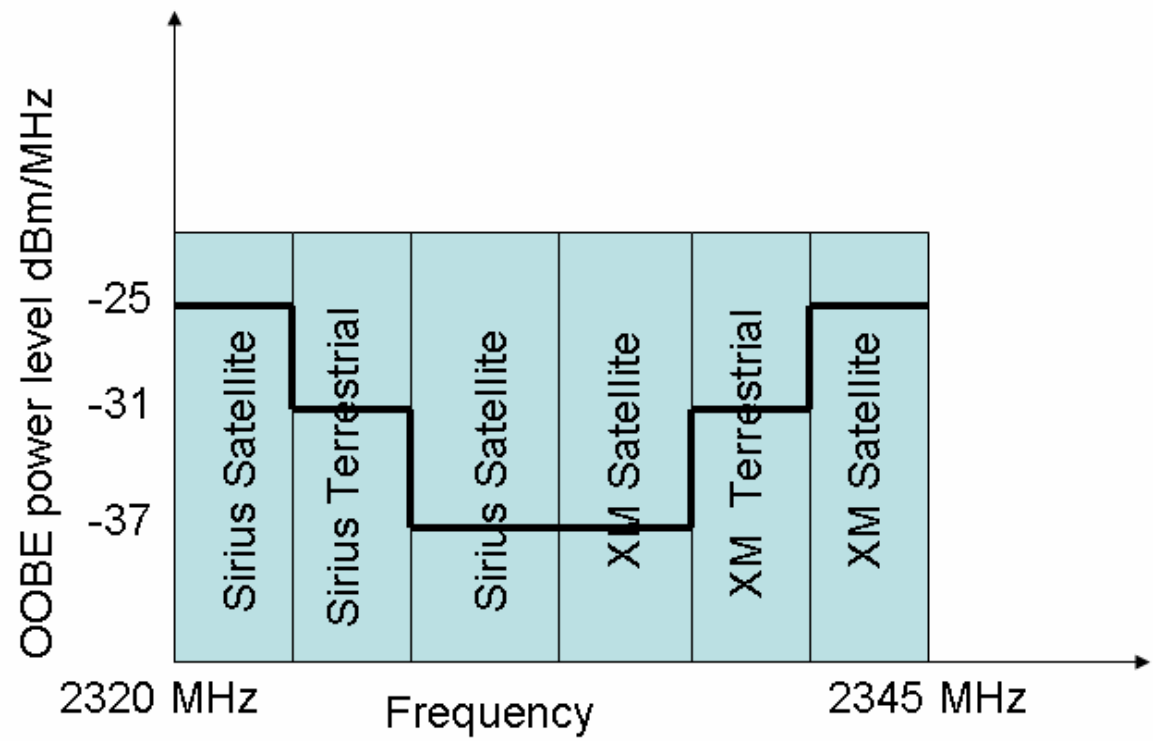


Figure 1. WCS Coalition proposed OOBE mask for mobile CPE

The Agilent ESG output waveform used in the testing is displayed on the screen of a spectrum analyzer and shown below:

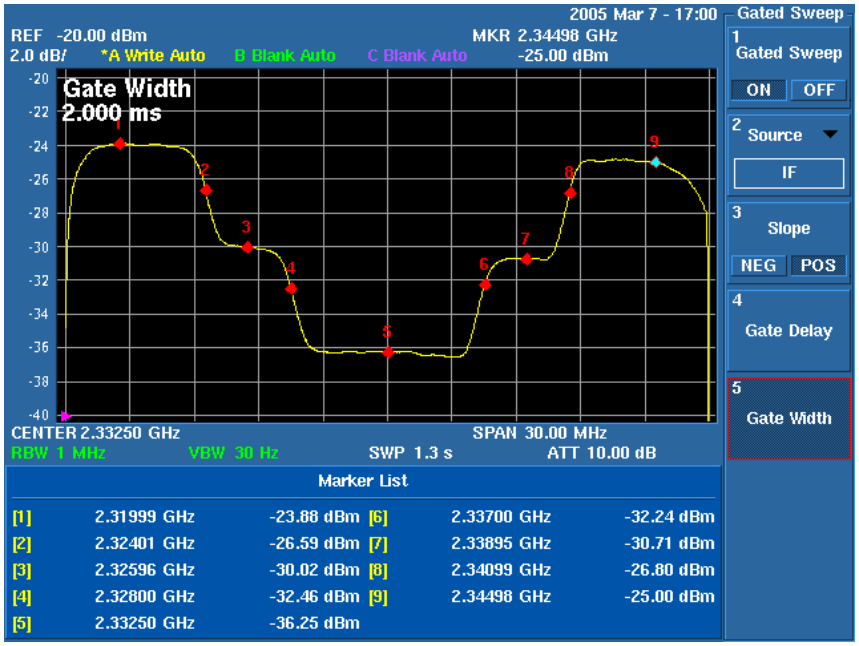


Figure 2. WCS Coalition Waveform for OOBE testing

Results Discussion

The results of the testing of the WCS Coalition's proposed stepped mask show that it provides protection to both Sirius and XM at the three meter separation distance designated by SDARS.[1] As shown in the following table from the ATECS test report, muting distances for the 6% duty cycle case are all less than the designated 3 meter separation distance. For the 43% duty cycle case, the separation distances necessary are increased somewhat. However, the testing was undertaken without the use of transmit power control. As shown below, once the effects of power control are considered, the 43% duty cycle cases also fall into the acceptable range.

[1] Comments of XM Radio Inc., WT Docket No. 07-293, at Ex. A § 2.3.9 (filed Feb. 14, 2008).

OOBE 'STEPPED MASK' TEST (satellite-only)	XM (+)				SIRIUS (+)		
	Distance to Mute (ft)				Distance to Mute (ft)		
DUTY CYCLE	Inno	Skyfi2	XM OEM		Sportster 5	ST1	Sirius OEM
6%	no muting	6	8		no muting	3	no muting
43%	18	20	24		8	7	21

Table 1: Muting distances for WCS proposed OOBE mask

To better understand the results and the degree to which the proposed mask protects the SDARS receiver at 3 meters, the coupling loss equation derived by ATECS during the recent testing is applied to the results. The coupling loss derived during the testing is shown in Table 2 below:

	Path Loss Near Field Range (5 to 50 ft)	Path Loss Far Field Range (5 to 100 ft)
Measurement 1	**49.3 + 22.6 LogD**	**51.7 + 18.7 LogD**
Measurement 2	**52.5 + 21.1 LogD**	**53.8 + 19.1 LogD**
Aggregate	50.9 + 21.8 LogD	52.7 + 18.9 LogD
Theoretical Free Space	40 + 20 LogD	40 + 20 LogD

Table 2: Coupling loss from field test measurement data with D in meters

We note that these coupling loss values presented above are virtually identical to the 52 + 22 Log (D) pathloss values measured independently by NextWave Wireless, Inc. in Del Mar, California and used to derive the simulated interference probabilities reported in the WCS Coalition's Comments.[2] Therefore, in addition to testing the effect of the proposed OOBE mask on SDARS receiver muting, the testing also validated the path loss assumptions used in the Coalition's simulation results.

Using the path loss equation for the Near Field Range of 50.9 + 21.8 Log D, the path loss for 3 meters distance is found to be 61.4 dB. Using the muting distances from Table 1 above, the pathloss between transmitter and receiver for the test cases shown in Table 1 is derived.

XM Muting Distance Pathloss (dB)

duty cycle	XM Inno	XM Skyfi2	XM OEM
6%	No mute	56.6	59.3
43%	67.0	68.0	69.7

[2] *See* Comments of WCS Coalition, WT Docket No. 07-293, at Ex. B (filed Feb. 14, 2008.

Table 3: XM Muting Pathloss

Sirius Muting Distance Pathloss (dB)

duty cycle	Sirius Sportster5	Sirius ST1	Sirius OEM
6%	No mute	50.1	No mute
43%	59.3	58.1	68.5

Table 4: Sirius Muting Pathloss

It is worth noting that many entries Tables 3 and 4 are less than 61.4 dB, meaning that these muting events occurred at a separation distance of less than 3 meters even without consideration of transmit power control. For those muting events which occurred at a greater distance than 3 meters, the extra attenuation required in order to normalize these muting events to a 3 meter effective distance can be computed. In Tables 5 and 6 below, only cells with yellow shading represent cases where extra attenuation is required – green cells indicate where no muting occurred at all (indicated by "no mute") or where muting occurred only within three meters (indicated by a negative number).

XM Extra Attenuation Required (dB)

duty cycle	XM Inno	XM Skyfi2	XM OEM
6%	no mute	-4.8	-2.1
43%	5.6	6.6	8.3

Table 5: XM Extra Attenuation required to prevent muting

Sirius Extra Attenuation Required (dB)

duty cycle	Sirius Sportster5	Sirius ST1	Sirius OEM
6%	no mute	-11.3	no mute
43%	-2.1	-3.3	7.1

Table 6: Sirius Extra Attenuation required to prevent muting

In order to prevent muting from OOBE within three meters, the extra attenuation indicated in the yellow-shaded cells in Tables 5 and 6 must be found. This extra attenuation need not come in the form of a more restrictive OOBE mask. In a real world application, additional attenuation will be experienced in many cases due to obstructions between the two antennas such as tinted vehicular glass, human bodies, and other vehicles, and the potential for interference is also further reduced by the limited

probability that a WCS user will actually be transmitting when in proximity to a SDARS listener. .

For present purposes, it is most efficient to focus on the proven fact that two-way mobile CPE using transmit power control will transmit below their full power capability most of the time. Under the WCS Coalition's proposal, the relaxed OOBE mask is only available to low power WCS user devices that employ transmit power control. This reduction in the power of the fundamental emission will also cause a reduction in the OOBE levels. NextWave has tested this relationship between transmit power and OOBE power and found that for every dB of reduction in the transmit power level, the OOBE will fall by 2.5 dB.[3]

In the simulation of interference scenarios between mobile WCS CPE and SDARS receivers contained in Attachment B of the WCS Coalition Comments, it was shown that 99% of the time the WCS CPE transmits with at least 3 dB of transmit power control. With the 2.5:1 dB relationship between OOBE and transmit power discussed above, it can be concluded that the OOBE will be reduced by at least 7.5 dB 99% of the time. Taking this OOBE reduction into account, the values in Tables 5 and 6 can be adjusted accordingly with the effect of virtually eliminating the cases where OOBE interference might be experienced by the SDARS receiver.

XM Extra Attenuation Required (dB) after OOBE reduction

duty cycle	XM Inno	XM Skyfi2	XM OEM
6%	no mute	-12.3	-9.6
43%	-1.9	-0.9	0.8

Table 7: XM Extra Attenuation required after adjusting for OOBE reduction

Sirius Extra Attenuation Required (dB) after OOBE reduction

duty cycle	Sirius Sportster5	Sirius ST1	Sirius OEM
6%	no mute	-18.8	no mute
43%	-9.6	-10.8	-0.4

Table 8: Sirius Extra Attenuation required after adjusting for OOBE reduction

There is only 1 case where the resulting OOBE from the WCS CPE could possibly mute the SDARS receiver, but even this case is questionable when the extra margin to prevent muting is only 0.8 dB, resulting in the need for a separation distance of 3.3 meters instead of 3 meters. This margin is comparable to the margin of error in the field testing. Again, it is notable that the assumptions for CPE power control and the resulting reduction in OOBE levels are based on the 99 percentile results from the interference simulation provided by the WCS Coalition in its Comments. It is very likely that CPE power and

[3] *See* Comments of WCS Coalition, WT Docket No. 07-293, at Ex. B (filed Feb. 14, 2008

OOBE levels will be less than those assumed for the testing results shown in the above tables.

As shown in the Tables above, the muting distances are much improved for the 6% duty cycle case compared to the 43% duty cycle case. It is expected that a 43% duty cycle is a value which is highly unlikely - in fact impossible with some technologies - and therefore the 43% duty cycle results are overly pessimistic. When considering what the actual duty cycle will be for a two-way broadband wireless WCS CPE, it must be recognized that the duty cycle in the long term will tend towards very low values (much less than 1% on a 24 hour or longer basis) because a broadband wireless or voice user is typically not transmitting data. However, when the user does have traffic in the uplink transmit buffer, the resulting short-term duty cycle of his transmissions will be determined by a number of factors such as system traffic load, user traffic load, user location in the cell coverage area, uplink data rate limits applied by the operator, and so on. The uplink duty cycle will be bounded at the high end by the characteristics of the radio transmission technology. For instance, with a TDD technology, such as TD-CDMA or WiMAX, time is divided between uplink and downlink transmissions on a system-wide basis, and the total time allocated to the uplink on a per-frame basis sets the upper bound for the uplink duty cycle.

For a TD-CDMA system, there are 15 timeslots in a radio frame. Typically 9 of these slots are allocated to user downlink traffic and 3 are allocated to user uplink traffic. The other 3 timeslots are dedicated to overhead signaling traffic. In this example, a user's uplink duty cycle would be bounded by the percentage of time that is allocated to uplink traffic. For this example, since only 3 of the 15 timeslots are allocated to uplink traffic, the maximum uplink duty cycle for CPE transmission is 3/15 or 20%. Therefore, in this case, a user on a TD-CDMA system would not be able to transmit with a duty cycle greater than 20%, resulting in an interference profile somewhere between the 6% and the 43% values in the Tables above.

For WiMAX, the uplink resource space is allocated in a slightly different manner. Users may receive allocations up to the 43% duty cycle that was tested, but typically the actual duty cycle will be much lower for users sharing resources with other users on a loaded system or again for users with typical Internet traffic, which is dominated by downlink traffic. For the most popular wireless application (voice), a user making a voice over IP (VOIP) call will require typically only a 6% duty cycle on the uplink to enable a full duplex voice conversation to occur. As indicated above, no cases of 6% duty cycle resulted in muting of the SDARS receiver at distances greater than 8 feet, so the SDARS desire for protection at 3 meters and greater separation distance is fulfilled.

An additional reference point for uplink duty cycle is GSM technology. While GSM is a 2nd generation, voice-centric technology, GSM is still in use today and has evolved to support low speed data services. For voice traffic, the maximum uplink duty cycle of GSM is 12.5%, but in current practice this duty cycle is reduced further by voice activity detection and adaptive vocoders, both of which are utilized to reduce cochannel interference in systems with a high degree of frequency reuse.

Therefore, as the analysis of the uplink duty cycle of various technologies shows, it is not unrealistic to expect that a certain percentage of WCS mobile users will generate uplink traffic with very low short term duty cycles, on the order of 6%, or at least significantly less than 43%.

Summary and Conclusions

The real world effect of the proposed WCS mobile CPE OOBE mask on both Sirius and XM receivers in satellite-only conditions was tested to find the separation distances required for various SDARS receiver models to prevent audio muting. Also tested was the effect of WCS CPE transmit duty cycle on the required separation distance. The results of this testing indicate that it is highly unlikely that real-world muting at separation distances greater than 3 meters would result from relaxing the WCS mobile CPE mask to the levels requested by the WCS Coalition. The results also validate the path loss equation used in the previous simulation work provided to the Commission by the WCS Coalition.

ATTACHMENT D

Impact of SDARS proposed operating limits on WCS buildouts

March 17, 2008

Next*Wave* Wireless

© 2008 Next*Wave* Wireless Inc. All Rights Reserved
Confidential and Proprietary

Overview

- **This presentation analyzes the impact of operating limits proposed by SDARS on base stations and user terminals operating in the WCS bands**
  - Maximum user terminal EIRP of +10 dBm for A/B-Blocks and 0 dBm for C/D-Blocks
  - Isotropic equivalent (ground level) signal power of -44 dBm for A/B-Blocks and -55 dBm for C/D-Blocks

- **The impact is analyzed by modeling a typical two-way wireless broadband network deployment for the greater Miami area**

- **The results show that SDARS proposed limits will significantly increase in the number of sites required for a coverage deployment**
  - A +10 dBm mobile transmit power limit will result in ***4 times*** more cell sites
  - A 0 dBm mobile transmit power limit will result in ***12 times*** more cell sites
  - A -44 dBm ground level limit will result in ***2 times*** more cell sites
  - A -55 dBm ground level limit will result in ***6 times*** more cell sites

© 2008 Next*Wave* Wireless Inc. All Rights Reserved

Overview

- **Analysis conducted for a typical two-way wireless broadband network deployment for the greater Miami area**
  - NextWave's TD-CDMA technology
  - A spreadsheet network dimensioning tool, calibrated with actual propagation prediction and network planning software tools, is used for the analysis
  - Baseline deployment based on a coverage build out for a mobile two-way service
  - Impact of proposed emission limits are determined by adjusting link budget and then computing the quantity of sites required to provide the same level of coverage as in the baseline case
  - Variance of new site quantities is compared to the baseline case

- **Analysis of the following cases are provided**
  - **Baseline:** Two-way mobile service with 54.5 dBm EIRP for base station and 24 dBm EIRP for user terminal
  - **Case #1:** User terminal transmit power limited to +10 dBm
  - **Case #2:** User terminal transmit power limited to 0 dBm
  - **Case #3:** Base station EIRP reduced by 4 dB (shown to be required to meet -44 dBm ground level limit)
  - **Case #4:** Base station EIRP reduced by 14 dB (shown to be required to meet -55 dBm ground level limit)

© 2008 Next*Wave* Wireless Inc. All Rights Reserved

Network Modeling Methodology

A calibrated spreadsheet tool is used to determine the number of cell sites required to satisfy the network coverage objectives

1. The coverage area objective is defined and the area is subdivided into land clutter categories (morphology)
2. Link budget design parameters including user data rates, coverage reliability, penetration margins, etc. are defined.
3. The user throughput SLA is used to determine achieve the lowest order modulation and coding scheme to be supported, i.e., the under “cell edge” condition defining the extent of coverage
4. The SINR associated with this modulation and coding scheme is used to derive the maximum allowable path loss (MAPL) to maintain that throughput given link budget parameters
5. The MAPL is used to estimate cell radius based on inputs governing the network deployment (e.g., antenna heights) and a calibrated radio propagation model (e.g., Cost-231 or SUI with area specific corrections).
6. The cell radius is used to calculate corresponding hexagonal cell area with an assumed coverage overlap and ultimately cell counts per morphology type

© 2008 Next*Wave* Wireless Inc. All Rights Reserved

RAN Design Inputs

	Dense Urban	Urban	Commercial and Industrial	Residential	Rural
Forward link throughput, cell edge (kbps)	1000				
Reverse link throughput, cell edge (kbps)	256				
In-building penetration margin (dB)	6	6	6	6	6
Base Antenna height (m)	25	25	22	20	28
Area coverage availability	95%	95%	95%	95%	95%
Cell edge coverage availability	85%	85%	85%	85%	85%
Channel Model	Required SINR values for Veh-A (30 km/hr) channel model				
User Terminal Device	Laptop PCMCIA card				

© 2008 Next*Wave* Wireless Inc. All Rights Reserved

Link Budget Variables

	Baseline	Case #1	Case #2	Case #3	Case #4
Base Station TX Power (dBm)	***40***	***40***	***40***	***36***	***26***
Antenna gain (dBi)	17.5	17.5	17.5	17.5	17.5
Cable loss (dB)	3	3	3	3	3
Base Station EIRP (dBm)	54.5	54.5	54.5	50	40
User Terminal Transmit Power (dBm)	***24***	***10***	***0***	***24***	***24***
UE Antenna Gain (dBi)	2	2	2	2	2
UE Rx Div Gain (dB)	3	3	3	3	3
Log Normal Fade Margin*	7 dB	7 dB	7 dB	0 dB	0 dB
Max Path Loss (dB)	**148**	**134**	**124**	**141**	**131**
Limiting Link	**UL**	**UL**	**UL**	**DL**	**DL**

* The fade margin must be excluded from the cases where impact of ground level limits for base stations is analyzed (while normally included in system design, inclusion of the fade margin in the DL would result in locations exceeding the specified limit)

NextWave WIRELESS

© 2008 Next*Wave* Wireless Inc. All Rights Reserved

Cell Radius Computations (calibrated SUI Model)

	Dense Urban	Urban	Commercial and Industrial	Residential	Rural
Land area (sq miles)	1	18	119	317	235
Total land area (sq miles)	690				
Baseline Coverage Design	.72	1.35	1.27	1.50	2.14
Case #1 – UT 10dBm, BTS 40 dBm	.39	.66	.63	.71	.95
Case #2 – UT 0dBm, BTS 40 dBm	.25	.39	.38	.42	.54
Case #3 – UT 24dBm, BTS 36 dBm	.52	.94	.89	1.03	1.43
Case #4 – UT 24dBm, BTS 26 dBm	.34	.56	.54	.60	.80

© 2008 Next*Wave* Wireless Inc. All Rights Reserved

Cell Sites per Morphology Computation

	Dense Urban	Urban	Commercial and Industrial	Residential	Rural
Land area (sq miles)	1	18	119	317	235
Baseline Coverage Design	1	5	32	60	22
Case #1 – UT 10dBm, BTS 40 dBm	3	18	130	268	110
Case #2 – UT 0dBm, BTS 40 dBm	7	50	353	780	347
Case #3 – UT 24dBm, BTS 36 dBm	2	9	65	127	50
Case #4 – UT 24dBm, BTS 26 dBm	4	25	175	370	156

© 2008 Next*Wave* Wireless Inc. All Rights Reserved

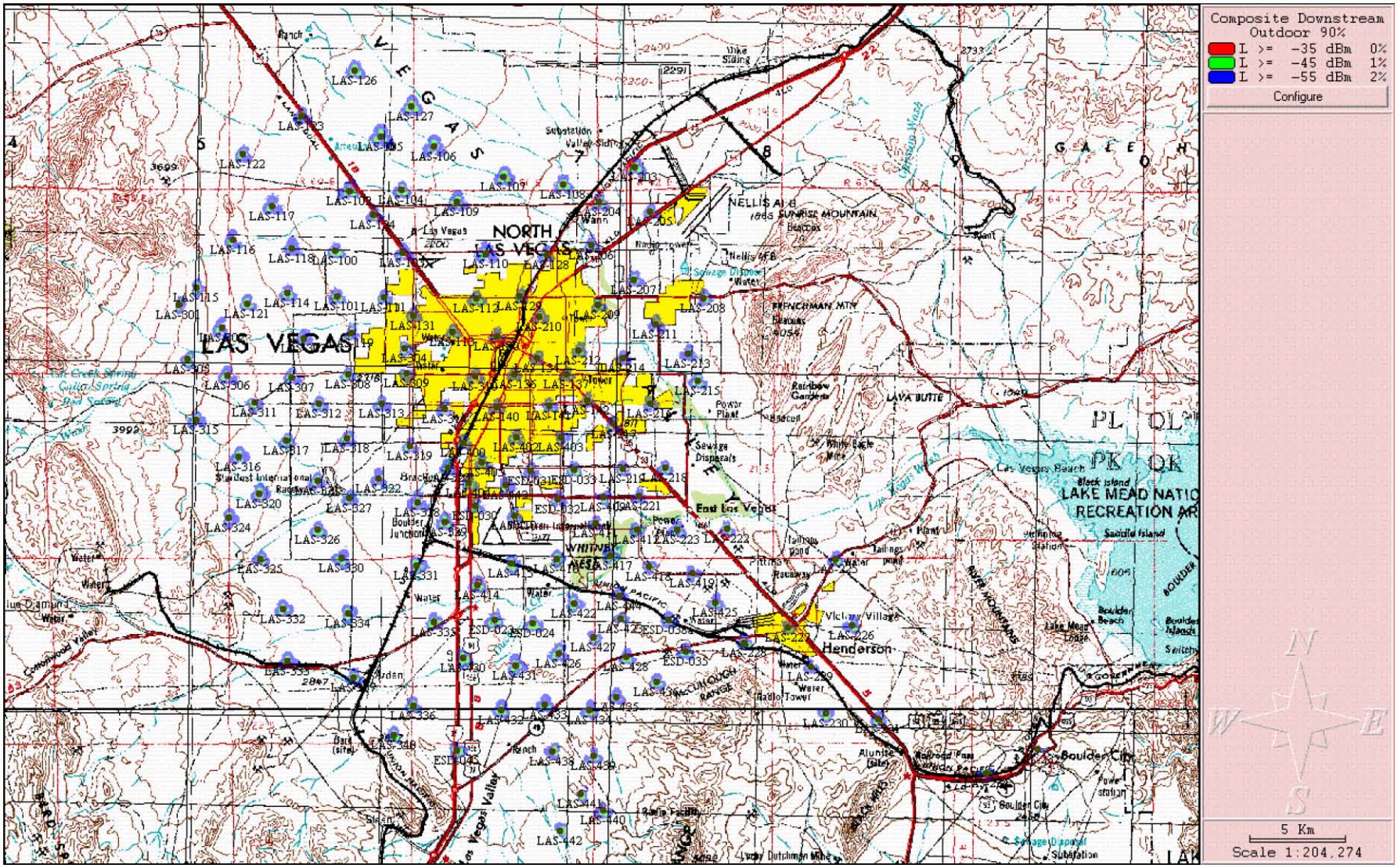
Summary Results

	Total Sites Required for Coverage	Ratio to Baseline Case
Baseline Coverage Design	120	1
Case #1 – UT 10dBm, BTS 40 dBm	529	4.4
Case #2 – UT 0dBm, BTS 40 dBm	1,537	12.8
Case #3 – UT 24dBm, BTS 36 dBm	253	2.1
Case #4 – UT 24dBm, BTS 26 dBm	730	6.1

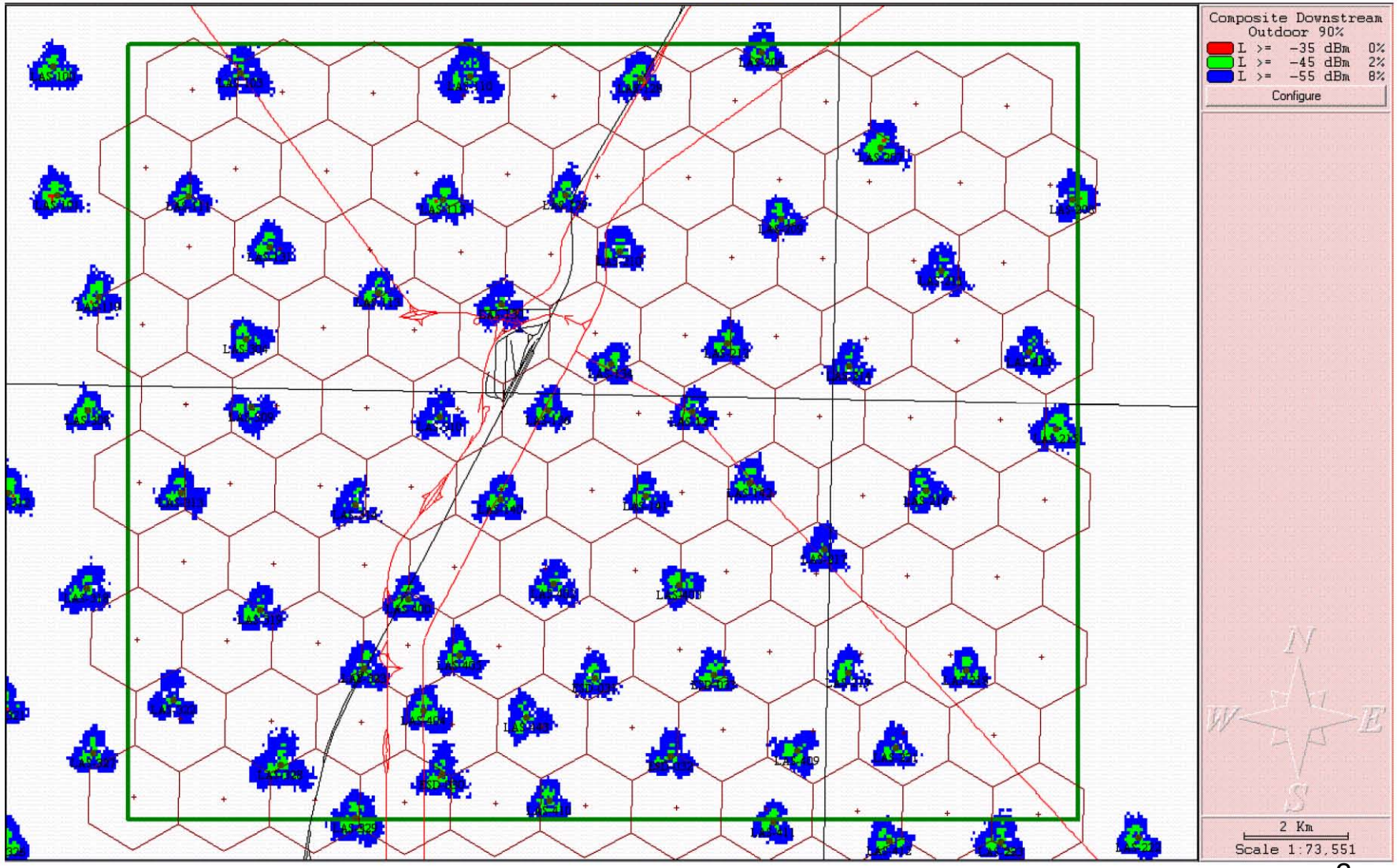
© 2008 Next*Wave* Wireless Inc. All Rights Reserved

ATTACHMENT E

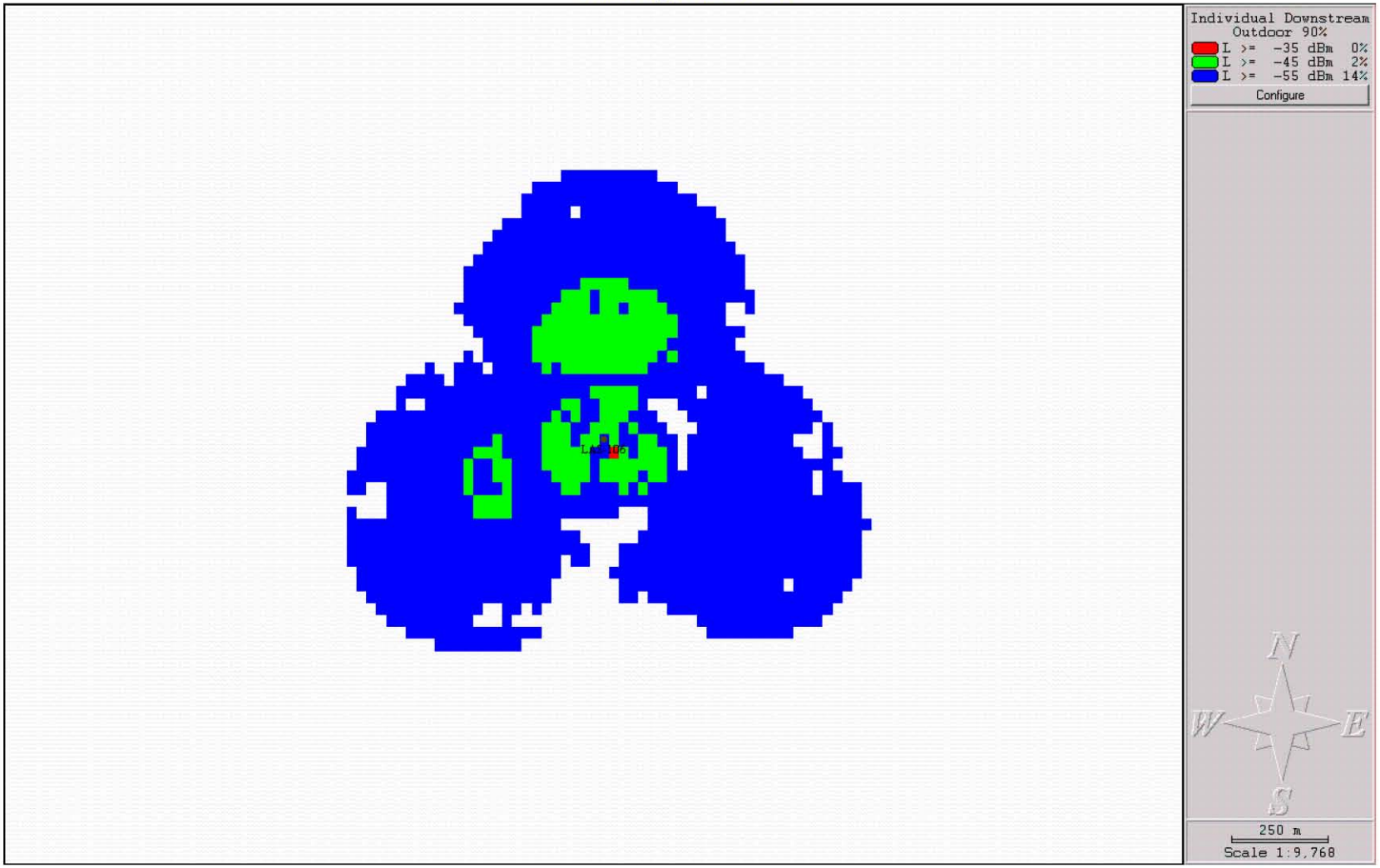
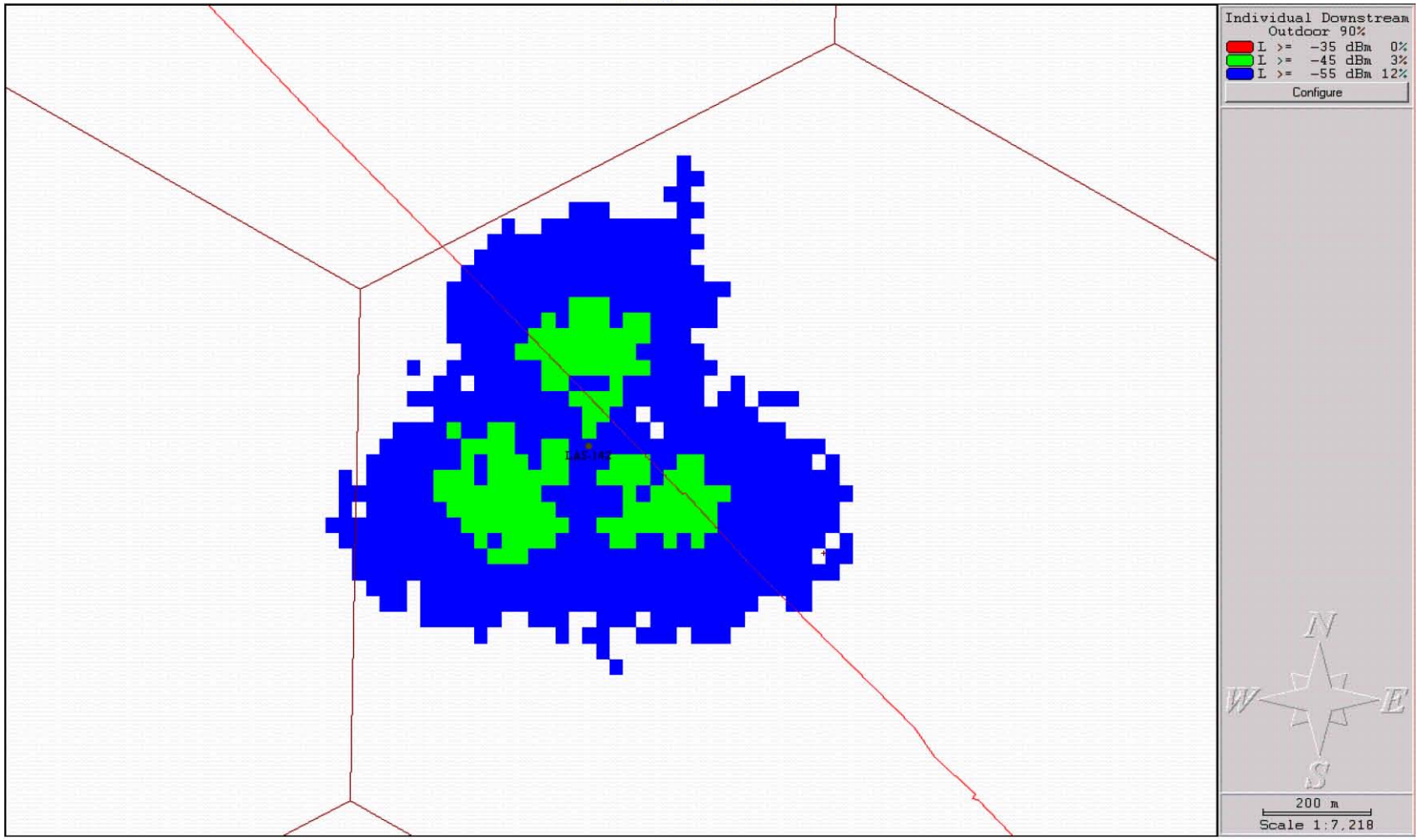
Las Vegas-WiMax Design(147)
Coverage-Out-Sub90&7dB FM
CPE@2m - ERP 54.75dBm


Composite Downstream
Outdoor 90%
L >= -35 dBm 0%
L >= -45 dBm 1%
L >= -55 dBm 2%
Configure
5 Km
Scale 1:204,274
LAS VEGAS
NORTH LAS VEGAS
Henderson
Boulder City
NELLIS AFB
LAKE MEAD NATIONAL RECREATION AREA
LAS-126
LAS-127
LAS-122
LAS-117
LAS-116
LAS-118
LAS-100
LAS-115
LAS-114
LAS-121
LAS-101
LAS-301
LAS-306
LAS-307
LAS-308
LAS-311
LAS-312
LAS-313
LAS-315
LAS-316
LAS-317
LAS-318
LAS-319
LAS-320
LAS-324
LAS-326
LAS-325
LAS-330
LAS-331
LAS-332
LAS-334
LAS-333
LAS-336
LAS-348
LAS-442
LAS-441
LAS-440
LAS-438
LAS-439
LAS-437
LAS-436
LAS-435
LAS-434
LAS-432
LAS-433
LAS-430
LAS-431
LAS-429
LAS-428
LAS-427
LAS-426
LAS-425
LAS-424
LAS-423
LAS-422
LAS-421
LAS-420
LAS-419
LAS-418
LAS-417
LAS-416
LAS-415
LAS-414
LAS-413
LAS-412
LAS-411
LAS-409
LAS-408
LAS-407
LAS-406
LAS-405
LAS-404
LAS-403
LAS-402
LAS-401
LAS-400
LAS-399
LAS-398
LAS-397
LAS-396
LAS-395
LAS-394
LAS-393
LAS-392
LAS-391
LAS-390
LAS-389
LAS-388
LAS-387
LAS-386
LAS-385
LAS-384
LAS-383
LAS-382
LAS-381
LAS-380
LAS-379
LAS-378
LAS-377
LAS-376
LAS-375
LAS-374
LAS-373
LAS-372
LAS-371
LAS-370
LAS-369
LAS-368
LAS-367
LAS-366
LAS-365
LAS-364
LAS-363
LAS-362
LAS-361
LAS-360
LAS-359
LAS-358
LAS-357
LAS-356
LAS-355
LAS-354
LAS-353
LAS-352
LAS-351
LAS-350
LAS-349
LAS-348
LAS-347
LAS-346
LAS-345
LAS-344
LAS-343
LAS-342
LAS-341
LAS-340
LAS-339
LAS-338
LAS-337
LAS-336
LAS-335
LAS-334
LAS-333
LAS-332
LAS-331
LAS-330
LAS-329
LAS-328
LAS-327
LAS-326
LAS-325
LAS-324
LAS-323
LAS-322
LAS-321
LAS-320
LAS-319
LAS-318
LAS-317
LAS-316
LAS-315
LAS-314
LAS-313
LAS-312
LAS-311
LAS-310
LAS-309
LAS-308
LAS-307
LAS-306
LAS-305
LAS-304
LAS-303
LAS-302
LAS-301
LAS-300
LAS-299
LAS-298
LAS-297
LAS-296
LAS-295
LAS-294
LAS-293
LAS-292
LAS-291
LAS-290
LAS-289
LAS-288
LAS-287
LAS-286
LAS-285
LAS-284
LAS-283
LAS-282
LAS-281
LAS-280
LAS-279
LAS-278
LAS-277
LAS-276
LAS-275
LAS-274
LAS-273
LAS-272
LAS-271
LAS-270
LAS-269
LAS-268
LAS-267
LAS-266
LAS-265
LAS-264
LAS-263
LAS-262
LAS-261
LAS-260
LAS-259
LAS-258
LAS-257
LAS-256
LAS-255
LAS-254
LAS-253
LAS-252
LAS-251
LAS-250
LAS-249
LAS-248
LAS-247
LAS-246
LAS-245
LAS-244
LAS-243
LAS-242
LAS-241
LAS-240
LAS-239
LAS-238
LAS-237
LAS-236
LAS-235
LAS-234
LAS-233
LAS-232
LAS-231
LAS-230
LAS-229
LAS-228
LAS-227
LAS-226
LAS-225
LAS-224
LAS-223
LAS-222
LAS-221
LAS-220
LAS-219
LAS-218
LAS-217
LAS-216
LAS-215
LAS-214
LAS-213
LAS-212
LAS-211
LAS-210
LAS-209
LAS-208
LAS-207
LAS-206
LAS-205
LAS-204
LAS-203
LAS-202
LAS-201
LAS-200
LAS-199
LAS-198
LAS-197
LAS-196
LAS-195
LAS-194
LAS-193
LAS-192
LAS-191
LAS-190
LAS-189
LAS-188
LAS-187
LAS-186
LAS-185
LAS-184
LAS-183
LAS-182
LAS-181
LAS-180
LAS-179
LAS-178
LAS-177
LAS-176
LAS-175
LAS-174
LAS-173
LAS-172
LAS-171
LAS-170
LAS-169
LAS-168
LAS-167
LAS-166
LAS-165
LAS-164
LAS-163
LAS-162
LAS-161
LAS-160
LAS-159
LAS-158
LAS-157
LAS-156
LAS-155
LAS-154
LAS-153
LAS-152
LAS-151
LAS-150
LAS-149
LAS-148
LAS-147
LAS-146
LAS-145
LAS-144
LAS-143
LAS-142
LAS-141
LAS-140
LAS-139
LAS-138
LAS-137
LAS-136
LAS-135
LAS-134
LAS-133
LAS-132
LAS-131
LAS-130
LAS-129
LAS-128
LAS-127
LAS-126
LAS-125
LAS-124
LAS-123
LAS-122
LAS-121
LAS-120
LAS-119
LAS-118
LAS-117
LAS-116
LAS-115
LAS-114
LAS-113
LAS-112
LAS-111
LAS-110
LAS-109
LAS-108
LAS-107
LAS-106
LAS-105
LAS-104
LAS-103
LAS-102
LAS-101
LAS-100
ESD-030
ESD-031
ESD-032
ESD-033
ESD-034
ESD-035
ESD-036
ESD-037
ESD-038
ESD-039
ESD-040
ESD-041
ESD-042
ESD-043
ESD-044
ESD-045
ESD-046
ESD-047
ESD-048
ESD-049
ESD-050
ESD-051
ESD-052
ESD-053
ESD-054
ESD-055
ESD-056
ESD-057
ESD-058
ESD-059
ESD-060
ESD-061
ESD-062
ESD-063
ESD-064
ESD-065
ESD-066
ESD-067
ESD-068
ESD-069

Las Vegas-Mt-WiMax Design(147)
Coverage-Out-Sub90&7dB FM
CPE@2m - ERP 54.75dBm



LAS-106- WiMax Design
Coverage-Out90%&7dBFM-Mod V
0dBi Rx Ant@2m - ERP 54.5dBm



LAS-142- WiMax Design
Coverage-Out90%&7dBFM-Mod V
Rx Ant@2m - ERP 54.5dBm