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September 19, 2007

**WRITTEN EX PARTE**
Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 Twelfth Street, SW
Washington, DC 20554

**Re: Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band - IB Docket No. 95-91, GEN Docket No. 90-357, RM-8610**

Dear Ms. Dortch:

Sirius Satellite Radio Inc. ("Sirius") and XM Radio Inc. ("XM") hereby respond to the recent filing of the WCS Coalition in this proceeding.[1] We welcome the cooperative spirit of the WCS Coalition filing and appreciate that there now appear to be several areas of mutual agreement.[2] At the same time, however, significant issues remain to be resolved.

Sirius and XM do not oppose plans by the WCS Coalition's members to use their spectrum to provide wireless broadband services, including using WiMAX or other technologies, but such deployments should not require any relaxation in the Part 27 rules or the imposition of any major burdens on the deployment of satellite radio repeaters. WCS licensees acquired their licenses knowing that they were essentially limited to the deployment of fixed services; absent compelling evidence that they can modify those

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[1] *See* Letter from Paul J. Sinderbrand, Counsel to the WCS Coalition to Marlene Dortch, Secretary, FCC (July 9, 2007) ("WCS Coalition Letter").

[2] The major areas of agreement appear to be the following:

- blanket licensing of satellite radio repeaters;
- exemption of very low power repeater transmitters from licensing restrictions;
- relying on 16 dB band pass filters in WCS transceivers to reduce potential interference from satellite radio repeaters;
- assessing interference levels via average power measurement;
- establishing inter-licensee coordination to share details about proposed new deployments; and
- commencement of a rulemaking proceeding that will formulate simultaneous changes to both Part 27 and Part 25 rules.

limits without adversely affecting millions of satellite radio listeners, they should be held to those limits.

As discussed further below and as supported by the attached Technical Annexes, the WCS Coalition's proposal to change significantly the rules to facilitate operation of WCS mobile user equipment would cause harmful interference to millions of satellite radio listeners, creating significant service quality degradation or complete dead-zones for satellite radio receivers as far as hundreds of meters around every WCS mobile unit. Such a proposal is clearly unacceptable and its adoption is contrary to the public interest.

Similarly, the WCS Coalition's proposal to control the interference environment solely through limits on transmit power rather than power flux density would lead to the creation of "hot spots" that would frequently wipe out satellite radio service in many areas; including areas around the WCS base stations that are likely to be located near major roads carrying vehicles of satellite radio users. The WCS Coalition suggests that satellite radio systems are sufficiently robust to accommodate such hot spots, but in fact the spatial diversity and buffering Sirius and XM have deployed are necessary to maintain the existing high-quality service required for a consumer entertainment service like satellite radio and do not provide sufficient margin for the kind of interference the WCS Coalition proposes to introduce. As the Commission recognized in the 700 MHz proceeding, a power flux density limit is much better and simpler than a limit on base station transmit power as a way to prevent interference between operations in adjacent bands without creating unnecessary restrictions on facilities deployment.[3] While the 700 MHz proceeding involved protecting terrestrial users from interference caused by other terrestrial systems, a power flux density requirement is even more appropriate to protect satellite radio receivers, receiving exceptionally low power satellite signals in the vicinity of terrestrial (WCS) transmitters. Moreover, while the WCS Coalition contends its proposed rules based on EIRP limits are straightforward and simpler than Sirius' proposal,[4] practical implementation of these rules will have the opposite effect. As described in the attached Annex 2, the WCS Coalition's rules would require complicated restrictions on base station height and antenna pattern in addition to raw EIRP limits.[5]

Finally, the WCS Coalition unfortunately continues to object to grandfathering existing satellite radio repeaters despite (1) there being no evidence that such repeaters would be materially problematic for WCS deployment and (2) the fact that replacing so many repeaters built long before any WCS deployments would require us to spend hundreds of millions of dollars and lead to enormous disruption in satellite radio service during a transition that would take years to complete.

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[3] *See Reallocation and Serv. Rules for the 698-746 MHz Spectrum Band (Tel. Channels 52-59)*, Report and Order, 17 FCC Rcd 1022, 1064 (¶ 105) (2002) ("700 MHz Order").

[4] *See* Petition of Sirius Satellite Radio Inc. for Rulemaking, and Comments, IB Dkt. No. 95-91, GEN Docket No. 90-357, RM-8610 (Oct. 17, 2006).

[5] *See* Annex 2 at 1.

## I. THE WCS COALITION'S PROPOSALS WOULD RESULT IN SIGNIFICANT INTERFERENCE TO SATELLITE RADIO

### A. The WCS Coalition's Proposed Rules for Mobile Service Would Cause Crippling Interference to Satellite Radio.

The WCS Coalition proposal for rule change calls for 2W EIRP limits on WCS mobile devices as well as relaxing the existing out-of-band emissions mask. As discussed further in Annex 1, we modeled the potential overload interference from a hypothetical WiMAX mobile device operating in the 2.3 GHz WCS band. Those models found that interference would cripple satellite radio reception at a considerable distance. Using signal-in-space characteristics consistent with equipment deployed in the nearby 2.5 GHz band, including WiMAX mobile terminals operating with up to 250 mW EIRP,[6] the model shows that the overload interference from such devices would degrade satellite radio reception within 115 meters of the interfering WCS devices, where one of the two satellite signals would be unusable. At a separation less than 26 meters, the satellite receiver would be rendered unusable by interference that is high enough to mute both satellite signals.[7] At 2W transmit power proposed by WCS, these interference distances would triple.

The WCS Coalition also proposes to reduce the Part 27 minimum suppression of out-of-band emissions from mobile WCS subscriber units by 55 dB – from 110 + 10 log (p)[8] to only 55 + 10 log (p) in the adjacent band.[9] In the attached Annex 1, we provide an analysis showing that the existing out-of-band emissions limit protects satellite radio receivers at a separation of 3.3 meters or more.[10] Using the WCS Coalition's proposed emissions mask, this separation distance to mitigate WCS out-of-band emission interference to satellite radio receivers increases to 1850 meters. Simply put, the WCS Coalition's request for a relaxation of the required out-of-band emissions suppression

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[6] *See* Annex 1. We used these WiMAX inputs published in the public documents because the WCS Coalition has so far not supplied any WCS service characteristics, system link budgets, or interference analysis.

[7] The WCS Coalition relies on WCS power control to reduce interference to satellite radio receivers. WCS Coalition Letter at 11, 12-13. Even utilizing transmitting power control, the WCS Coalition's proposed rules for mobile operations would still result in significant interference to satellite radio receivers, including during the periods when they are operating 5 dB below maximum authorized power. *Id* at 11. The WCS Coalition did not offer a supporting analysis regarding this matter and the resulting power control effect may be as low as 0 dB, depending upon the network implementation details, especially near the cell boundary and at most cell locations in densely built urban areas where the user terminal is forced to transmit at highest power levels.

[8] 47 C.F.R. § 27.53(a)(2) (2006).

[9] *See* WCS Coalition Letter at Exh. A, proposed rule § 27.53(a)(2) (appended as Exh. A "Draft Modifications to Parts 25 and 27" to the WCS Coalition Letter). The WCS Coalition would require somewhat greater suppression in satellite radio spectrum further from the band edge.

[10] *See* Annex 1.

coupled with EIRP-based transmitter limits would generate massive harmful interference to satellite radio at a level that could threaten the viability of the service.

### B. The 2.3 GHZ Band Was Primarily Designed for Fixed Services.

Contrary to the WCS Coalition's claim, the Commission, in writing the original rules for WCS, expressly discouraged mobile WCS operation by imposing stringent out-of-band emission limits on WCS mobile devices. The FCC forthrightly and unequivocally stated that protecting satellite radio may "make mobile operations in the WCS spectrum technologically infeasible."[11] The Commission expressly imposed out-of-band emission limits that are "necessary to protect…satellite DARS licensees from interference from WCS operations."[12] As the Commission appropriately recognized, the need to overcome fading and multipath interference leaves insufficient margin for satellite radio operators to overcome higher power signals generated in the adjacent band.[13] The agency went out of its way to "caution prospective WCS licensees…to carefully consider whether their anticipated uses and business plans can be successfully implemented under the additional technical and operational restrictions necessary to qualify for the lesser out-of-band emission limit."[14] The WCS Coalition's members were well aware of this condition before bidding for licenses—and the entire 30 MHz WCS spectrum was auctioned for under $14 million,[15] reflecting widespread understanding of

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[11] *See Amendment of the Comm'n's Rules to Establish Part 27, the Wireless Commc'ns Serv.*, Report and Order, 12 FCC Rcd 10785, 10787 (¶ 3) (1997) ("WCS Recon Order").

[12] *Id.*

[13] The only portable WCS implementation the Commission accommodated was based on a particular low-power technology (likely to be operated indoors) proposed by PPF/Digivox, which assumed a 0.2 W mobile transmitter and an 0.8 W base station with a 12.5 percent duty cycle. These low power levels suggest a local area network implementation, not a wide area implementation such as WiMAX commercial mobile broadband service. In any event, the FCC already considered low-power portables and already relaxed out-of-band limits for such units— only to 93 + 10 log (p), which is 25 – 38 dB more protective than what the WCS Coalition proposes to apply to WCS mobile devices operating with up to 2 watts. *Amendment of the Comm'n's Rules to Establish Part 27, the Wireless Commc'ns Serv.*, Memorandum Opinion and Order, 12 FCC Rcd 3977, 3991 (¶ 26) (1997) ("WCS MO&O"); 47 C.F.R. § 27.52(a)(9).

[14] WCS MO&O, 12 FCC Rcd at 3979 (¶ 5) (warning potential WCS bidders that "wide area, full mobility systems and service such as those being provided or anticipated in the cellular and PCS bands are likely to be of questionable feasibility").

[15] *See* Press Release, *WCS Auction Closes*, Public Notice, 12 FCC Rcd 21,653 (1997) (noting that Auction 14, the WCS auction, "rais[ed] a net total of $13,638,940 for the U.S. Treasury"). *See also* George Gilder, *Free Markets for Telecom*, WALL ST. J., Sept. 16, 1997, at A22 ("The so-called Wireless Communications Service auction in April saw licenses in St. Louis, Minneapolis, Milwaukee, Des Moines, Iowa, and Omaha, Neb., go for just $1 per person -- a fraction of 1% of the value of previous licenses."). In fact, in each of these cases, winning bidders in the WCS auction paid only $1 <u>for the entire market</u>.

technical limitations in the band.[16] Indeed, the agency twice considered previous, timely reconsideration requests.[17]

Over the years, the development of WCS services reflected these limits on mobile operations. WCS licensees successfully tested fixed wireless broadband services in their spectrum. From the start, consistent with the technical characteristics of the WCS band, the licensees publicly promoted "fixed wireless broadband access"[18] and offerings akin to multipoint multichannel distribution,[19] not mobile services. Indeed, fixed WCS equipment is FCC type accepted and available[20] and some WCS licensees have built and deployed fixed WCS networks.[21] These technologies promise a more than fair return on the WCS licensees' minimal investment in the 2.3 GHz spectrum.

The WCS Coalition asserts that the Commission must adopt its proposed rules in order to assure that WiMAX deployment can occur in the 2.3 GHz band. However, the deployment of WiMAX in the 2.3 GHz band does not require deployment of mobile service and, even if it did, deployment of WiMAX in the United States is not dependent upon the 2.3 GHz band. Other bands are available and are being actively developed for WiMAX deployment, in compliance with existing interference standards. In contrast, the Commission has recognized that "the 2320-2345 MHz frequency band is the only spectrum specifically available for provision of Satellite DARS in the United States," and that "if Satellite DARS in this spectrum is subject to excessive interference, the service will not be successful and the American public will not benefit from the service."[22] The

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[16] In contrast, the 25 MHz of spectrum auction for satellite radio licenses raised approximately $170 million. *See* Press Release, *FCC Announces Auction Winners for Digital Audio Radio Service*, Public Notice, 12 FCC Rcd 18727 (1997).

[17] *See* WCS Recon Order, 12 FCC Rcd at 10,785; *Emergency Motion of the Wireless Cable Ass'n Int'l, Inc. for a Stay of the Wireless Commc'ns Serv. Auction and Associated Rules*, FCC 97-111 (April 1, 1997).

[18] *Evolution of the Wireless Cable Ass'n*, Private and Wireless Broadband Magazine (Mar. 2000), http://www.broadbandproperties.com/2000%20issues/march/andy-kreig.htm (last visited Aug. 27, 2007).

[19] Dan O'Shea, BellSouth Buy May Boost MMDS Prospects, TelephonyOnline.com, May 19, 2003 at http://telephonyonline.com/access/print/telecom_bellsouth_buy_may/index.html, last visited (Aug. 27, 2007).

[20] *See* Equipment Authorization FCC ID PL6-2300-BTS3-R1 (equipment authorization for Navini Networks base station transceiver operating in the 2305-2320 and 2345-2360 MHz bands); Experimental License No. 0187-EX-PL-2007 (experimental license of Horizon Wi-Com to test fixed wireless broadband service, utilizing Navini modem equipment). Alvarion BMAX-BST-AU-ODU-HP-2.3 Base Station for A/B blocks, FCC ID LKT-BMAX-BA23; Alvarion BMAX-CPE-ODU-PRO-SA-2.3 subscriber unit , FCC ID LKT-BMAX-SU23.

[21] *See* Press Release, "AT&T Announces Availability of Fixed Wireless High Speed Internet Access in Pahrump," Nov. 16, 2006, *available at* http://www.att.com/gen/press-room?pid=4800&cdvn=news&newsarticleid=23161 (last visited Aug. 27, 2007) (announcing the availability of fixed wireless broadband service using 2.3 GHz spectrum in Pahrump, NV).

[22] WCS MO&O, 12 FCC Rcd at 3992 (¶ 27).

same is true today, and the potential for disruptive interference impact is even greater, with over 15 million satellite radio subscribers and many millions more listeners.

### C. The WCS Coalition's Proposal to Limit Transmit Power Rather Than Power Flux Density Would Lead to Untenable Interference in the 2.3 GHz Band

The WCS Coalition proposes to allow unrestricted use of 2 kW average EIRP base stations. The Coalition grounds this request on the unsustainable principle that WCS base stations are entitled to "technical parity" with satellite radio repeaters. As discussed more fully in the attached Annex 3, history provides no basis for this notion.[23]

Most importantly, the Coalition's approach would result in more interference throughout the band than would adoption of Sirius' proposal to limit PFD on-the-ground in the immediate vicinity of both WCS and satellite radio transmitters. To illustrate this, Annex 2 includes graphs of the overload areas that would be experienced by satellite radio receivers from a single WCS base station operating at 2 kW average EIRP.[24] Particularly, one example illustrates interference conditions from a WCS base station site operating two blocks from major highways (I-105 and I-110) in Los Angeles, CA.[25] This single WCS base station would result in overload conditions within four to seven blocks of residential and commercial areas surrounding the site as well as on the nearby highways, blocking satellite radio reception to the thousands of cars that drive on these major roads daily. This level of interference would result from only a single transmitter. If WCS licensees were to deploy a cellularized WiMAX system in Los Angeles, the result would be an overlapping patchwork of dead zones that would essentially block satellite radio reception throughout the city. The same effect would be replicated and spread throughout markets wherever the 2 kW average transmit power base stations (proposed by the WCS Coalition) were operated, creating more significant interference conditions. Also note that the 2 kW average base station transmit power limit (proposed by the WCS Coalition) would at least quadruple the interference area around a base station beyond the current limit of 2 kW peak power for the satellite radio receivers operating with relatively weak satellite signals.

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[23] *See* Annex 3. Rather than parity, the Commission adopted technical limits on WCS operations that were "necessary to protect…satellite DARS licensees from interference from WCS operations." WCS Recon Order, 12 FCC Rcd at 10787 (¶ 3). The Commission itself recognized that these two services would not operate in technical parity by establishing an EIRP limit on WCS base stations while refraining from imposing such a limit on satellite radio repeaters. Sirius' proposed rules would apply a PFD limit in parity to WCS base stations and satellite radio terrestrial repeaters prospectively.

[24] The Coalition's 2 kW average EIRP proposal represents a four times increase in the allowed base station power limits from the current 2 kW peak EIRP rule for fixed WCS base station transmitters, 47 C.F.R. § 27.50(a), assuming 6 dB peak to average power ratio for the employed transmission signal.

[25] *See* Annex 2 at 4-9.

Though WCS licensees might not deploy 2 kW average WiMAX transmitters in a cellular deployment, the possibility cannot be ruled out.[26] Indeed, this point highlights a long-standing frustration of both XM and Sirius that is only complicated by the Coalition's sea-change toward a mobile WiMAX deployment. For more than 10 years now, we satellite radio providers have had to implement our networks without any certainty regarding the technical and operational parameters of our adjacent band neighbors. Accordingly, current satellite radio repeater networks were designed based on the existing WCS rules and the available evidence on wireless product designs suitable for the WCS band operation. Any changes in those rules would increase the potential for interference to 15 million satellite radio listeners, and would be extraordinarily unfair and disruptive to the licensees and the public.

Moreover, the WCS Coalition's 2 kW average EIRP model is unnecessarily complicated. Though the WCS Coalition faults a PFD on-the-ground solution as overly complex and unworkable, the WCS Coalition's approach is actually far more complex than a PFD limit. The WCS Coalition's proposal also would require the Commission to adopt complicated Commission rules limiting the heights of WCS antennas and antenna patterns. Annex 2 provides an analysis and example coverage plot that demonstrates that "EIRP limit alone does not ensure control of the blanket interference environment surrounding the transmitter" and that, in practice, use of an EIRP limit makes it "necessary to add to any EIRP limit several other technical limits which would result in rules that are more complex and less effective than ground based limits."[27]

The WCS Coalition proposal also would require codifying the measurement bandwidth for WCS and satellite radio – twice – with one limit applicable over 5 MHz and another over 1 MHz.[28] Plus, the WCS Coalition proposes distinct narrow-band measurements when evaluating WCS out-of-band emissions.[29]

In contrast, a PFD limit is simple and does not require knowing or limiting other transmitter characteristics. Because the PFD approach focuses on signal density, it preserves the licensee's flexibility with regard to power, height, gain, and other technical parameters. A power flux density limit on both WCS base stations and satellite radio repeaters would provide both services with a baseline operational environment that would allow each licensee to make rational and independent decisions on transmitter design and deployment by conforming only to a single technical parameter. This necessary method efficiently coordinates the interference conditions in this complex 2.3 GHz band allocation between the licensees of satellite radio systems operating with weak satellite

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[26] As a point of reference, the maximum permitted power for the Broadband PCS Service is 1640 watts EIRP in non-rural areas. *See* 47 C.F.R § 24.232.

[27] *See* Annex 2 at 1.

[28] *See* WCS Coalition Proposed Rule § 25.xx(a) (in Proposed Revisions to Part 25 Section).

[29] WCS Coalition Proposed Rule § 27.53(a)(2).

signals and the licensees of the terrestrial radio systems operating with relatively strong signals.

The FCC has adopted PFD limits elsewhere to minimize potential interference between dissimilar adjacent band services. In the Lower 700 MHz band, for example, the FCC adopted PFD limits to allow relatively high powered digital broadcast services (up to 50 kW) on frequencies immediately adjacent to low power advanced wireless services.[30] In so doing, the Commission noted that the "PFD standard will minimize the likelihood of adjacent channel interference to ground-based devices by effectively limiting the energy received by such devices to levels no greater than what they would receive from adjacent channel base stations operating at [lower power.]"[31] Clearly, similar consideration is needed in the 2.3 GHz band.

Similarly, the FCC adopted PFD limits on ancillary terrestrial transmitters associated with mobile satellite systems to minimize the threat of interference to adjacent band satellite receivers located aboard aircraft that are on the ground.[32] There, the FCC protected satellite receivers by limiting the amount of energy that would be received by adjacent-band terrestrial transmitters in airports. This interference scenario is replicated in the 2.3 GHz WCS/Satellite radio bands and therefore requires a similar prophylactic response. In short, the FCC has previously recognized the benefits of managing interference through street level power limits – the core of Sirius' proposal – especially when confronted with adjacent services that operate with great variances in operating power.

### D. The WCS Coalition Understates the Susceptibility of Satellite Radio to Interference

The WCS Coalition argues that any increased interference created by its proposed rules can be accommodated by "the multiple diversity path system design employed by both DARS licensees."[33] However, the Sirius White Paper[34] already accounted for diversity, and Sirius' proposed rules were carefully calculated to accept the maximum level of WCS interference that only barely preserved a single space-to-earth path at an interference power level at -44 dBm while muting the other satellite link long before at

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[30] *See* 47 C.F.R. § 27.55.

[31] *See* 700 MHz Order.

[32] *See* MSS/ATC Order, *Flexibility for Delivery of Commc'ns by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands; Review of the Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Serv. Sys. in the 1.6/2.4 GHz Bands*, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd 1962, 2040 (¶ 154) (2003).

[33] WCS Coalition Letter at 11.

[34] *See* White Paper: Interference to the SDARS Service from WCS Transmitters at 11 (attached to Letter from Carl Frank, Counsel to Sirius to Marlene H. Dortch, Secretary, FCC, IB Dkt. No. 95-91 (Mar. 30, 2006))("Sirius White Paper").

the lower interference power level of -57 dBm. Ignoring this engineering amounts to "double counting."[35] Increased interference conditions could be ameliorated *only* by massive multiplication of satellite radio repeater networks—the very thing the WCS Coalition claims it seeks to avoid.[36] This method could still not be relied upon to solve effectively the significant mobile interference issue. Moreover, because satellite radio operates in a multipath environment, the WCS Coalition is also wrong to contend that polarization or angular discrimination may be relied on for reducing interference.

## II. GRANDFATHERING EXISTING REPEATERS IS REASONABLE AND DOES NOT MATERIALLY IMPACT WCS DEPLOYMENT

Though the WCS Coalition opposes the grandfathering of repeaters that Sirius and XM currently operate under Special Temporary Authority, grandfathering existing satellite radio repeaters is fair and feasible. Satellite radio licensees have spent hundreds of millions of dollars to deploy repeaters and have millions of subscribers who depend on repeaters to receive the diverse content that satellite radio provides. The WCS Coalition's approach unnecessarily would force satellite radio licensees to add hundreds of lower-power repeaters, rapidly and at huge expense. Such an undertaking is practically impossible, would cost hundreds of millions of dollars, and would entail significant disruption to satellite radio service as the old system was turned off and the new system tested and deployed – all without any showing that the existing repeaters are a material problem to the deployment of WCS operations. Moreover, the interference that would be caused by the proposals the WCS Coalition makes to facilitate the deployment of WCS mobile services could not be overcome even if satellite radio operators were to spend hundreds of millions of dollars on a new repeater configuration.

The bottom line is that there is a substantial record showing that WCS licensees can design networks around existing and known repeaters at no or minimal additional cost.[37] In stark contrast to the costs incurred, the equipment deployed, and the service

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[35] WCS Coalition Letter at 12-13.

[36] To this end, the WCS Coalition calls the Sirius petition "flawed" because it fails to consider the "widespread terrestrial repeater deployments" by XM and Sirius that will continue to provide service to satellite radio subscribers even if the satellite signal is disrupted by WCS transmissions. *See* WCS Coalition Letter at 11 n.30. Yet, inconsistently, the WCS Coalition recommends that Sirius and XM "add new repeaters freely" to overcome the loss of its satellite signal by WCS transmitters. *Id.* at 11 n.29.

For the record, we note that the combined satellite radio terrestrial repeater networks of Sirius and XM cover less than 1% of the area of the contiguous United States: far less ubiquitous than the WCS Coalition implies. Furthermore, it is our full intent to offer satellite service primarily via satellite delivery as intended by the FCC allocation of spectrum. We are perplexed as to why the WCS Coalition would support a solution that encourages the deployment of more satellite radio terrestrial repeaters after its members have fought the establishment of these repeaters for nearly a decade. By contrast, the solution proposed herein would prevent a "power war" between adjacent services; not promote one.

[37] Per page 63 of the product specification document, Alvarion Wimax receivers are advertised to overload from high input signal power levels at -20 dBm. BreezeMAX CPEs Preliminary Product Manual,

provided by the satellite radio licensees, WCS licensees have invested almost nothing and deployed only sparsely.

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Therefore, based on the foregoing, Sirius and XM urge the Commission to reject the proposals of the WCS Coalition. We also encourage the WCS Coalition to abandon its plans for mobile deployment and reconsider Sirius and XM's proposals to adopt a PFD limit for the 2.3 GHz transmitters. Sirius and XM continue to believe that this proceeding can be completed in a manner that allows WCS Coalition members to deploy 2.3 GHz networks and preserves satellite radio as a successful, high-quality service for millions of Americans.

Very truly yours,

*/s/ Patrick L. Donnelly*
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Oct. 2006, *available at* https://fjallfoss.fcc.gov/prod/oet/forms/blobs/retrieve.cgi?attachment_id=719454&native_or_pdf=pdf (last visited September 10, 2007). Note that the satellite radio coordination proposal limits the satellite radio repeater power levels from the future satellite radio repeater sites to -44 dBm on the street, well below the power levels tolerable by the available Wimax receiver products.

# ANNEX 1

# Annex 1: Impact of WCS Mobile Devices

If the existing rules are changed to facilitate WCS licensees providing mobile service,[1] their mobile devices will create large interference zones for satellite radio receivers. The example below illustrates the predicted satellite radio reception exclusion zone that would be caused by the WCS mobile interference.

Analysis of out-of-band emission interference from a WCS Mobile.

1. The FCC has recently used 0.25 dB (6%) noise floor increase[2] and 1.0 dB (25%) noise floor increase[3] as the interference threshold for setting out of band emissions limits. Following is a calculation considering the significance of out-of-band emissions using each case.
2. Using the satellite radio noise floor of -111 dBm,[4] an increase in the noise floor of 0.25 dB is caused by an in-band interference power level of -123 dBm (or -130 dBm/MHz). A 1.0 dB increase is caused by an interference power level of -117 dBm (or -123 dBm/MHz).
3. The current WCS mobile OOBE limit of 110 +10logP limit reduces the emission in the satellite radio band at the transmitter to -80 dBm/MHz regardless of the transmitter power.
4. At a 3.3 meter separation distance from the WCS mobile transmitter, the WCS out-of-band emissions within the satellite radio band will be reduced through line-of-sight path loss by 50 dB to -130 dBm/MHz where it raises the satellite radio receiver's noise floor by 0.25 dB. Similarly, at a 1.5 meter separation distance, the WCS out-of-band emissions will be reduced by 43 dB to -123 dBm/MHz where it raises the SDARS receiver's noise floor by 1.0 dB.
5. An increase of the allowed OOBE limit of 55 dB (relaxing the current 110+10logP mask to 55+10logP) would allow the WCS out-of-band emission level at the transmitter to be -25 dBm/MHz, causing a significant noise floor increase in the satellite radio band.

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[1] *See* Letter from Paul J. Sinderbrand, Counsel to the WCS Coalition to Marlene Dortch, Secretary, FCC (July 9, 2007) ("WCS Coalition Letter").

[2] *Flexibility for Delivery of Commc'ns by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands; Review of the Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Serv. Sys. in the 1.6/2.4 GHz Bands*, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd 1962, 2043-44 (¶ 143) (2003) ("*MSS/ATC Order*").

[3] *Amendment of the Comm'n's Rules to Establish Part 27, the Wireless Commc'ns Serv.*, Memorandum Opinion and Order, 12 FCC Rcd 3977, 3992 (¶ 29) (1997) ("WCS MO&O").

[4] *See See* White Paper: Interference to the SDARS Service from WCS Transmitters at 17 (attached to Letter from Carl Frank, Counsel to Sirius to Marlene H. Dortch, Secretary, FCC, IB Dkt. No. 95-91 (Mar. 30, 2006))("Sirius White Paper").

6. As a result, the out-of-band emission interference distance around a WCS terminal would increase to 1850 meters for the 0.25 dB threshold case, and to 860 meters for the 1.0 dB threshold case. This would result in significant service quality degradation for satellite radio receivers within these separation distances. Obviously, the interference effects would worsen as the separation distance between the WCS interferer and the victim satellite radio receivers decreases, or if the number of WCS interferers increases.

Analysis of primary (in-band) transmission interference from a WCS Mobile.

1. Using 250 mW EIRP as a baseline for a WCS mobile transmitter, we have estimated that the distance at which overload interference mutes signals from one of the satellite radio satellites to be 116 meters (yielding a 42,273 square meter near-dead zone for satellite radio around the WCS transmitter).
2. This condition occurs when the received interference signal at the satellite radio receiver reaches -57 dBm.[5]
3. The corresponding distance where a WCS interferer transmitting at 250 mW exceeds Sirius' proposed ground level interference coordination limit of -44 dBm is 26 meters (yielding a 2043 square meter completely-dead zone for satellite radio around the WCS transmitter).
4. This proposed -44 dBm ground based interference coordination limit reflects a compromise that would accept catastrophic interference on one satellite radio satellite stream while leaving the second stream marginally operational.
5. As such, operation of a WCS mobile device transmitting at 250 mW within 26 meters of an satellite radio receiver would result in a complete loss of both satellite signals. Increasing transmit power to 2 W would increase the interference distance to 73 meters.

[5] *Id.* at 13.

# ANNEX 2

# Annex 2: Discussion of the benefits of using a PFD limit

This annex compares the potential use of transmitter EIRP limits as an alternative to ground level signal limits. It is shown that specifying an EIRP limit alone does not ensure control of the blanket interference environment surrounding the transmitter. In practice, it is necessary to add to any EIRP limit several other technical limits which would result in rules that are more complex and less effective than ground based limits.

In order to relate the transmitter EIRP to the actual interference levels at a victim receiver, it is necessary to calculate the path loss that exists between the transmitter and a receiver. The calculation of this path loss involves making assumptions about the height of the antenna above ground, the antenna pattern, the angle of down tilt and the type of physical environment surrounding the transmitter.

It is seen from the analysis that the resulting potential for interference is uncertain due to the differing types of physical environments (and associated path losses) that can potentially exist between the transmitter and the victim receiver. It is because of this that a rule specifying ground based PFD limits, independent of the environment of the transmitter, offers more control of blanket interference while allowing more flexibility in antenna placement and site design.

The benefits of a PFD specification have already been recognized in the current WCS Part 27 rules for the 700MHz band,[6] although at levels 20 dB higher than Sirius has proposed, reflecting additional margin requirements due to the difference between interference into a satellite vs. a terrestrial originated signal.

[6] 47 C.F.R. § 27.55 (b) (2007).

## *1.1 Analysis*

### 1.1.1 Antenna pattern

In order to provide a framework independent of the actual antenna used, an Omni antenna reference pattern was used from ITU-F1336.[7] For this type of antenna, down tilt is implemented electrically as opposed to mechanically. The pattern used is shown in Figure 1.

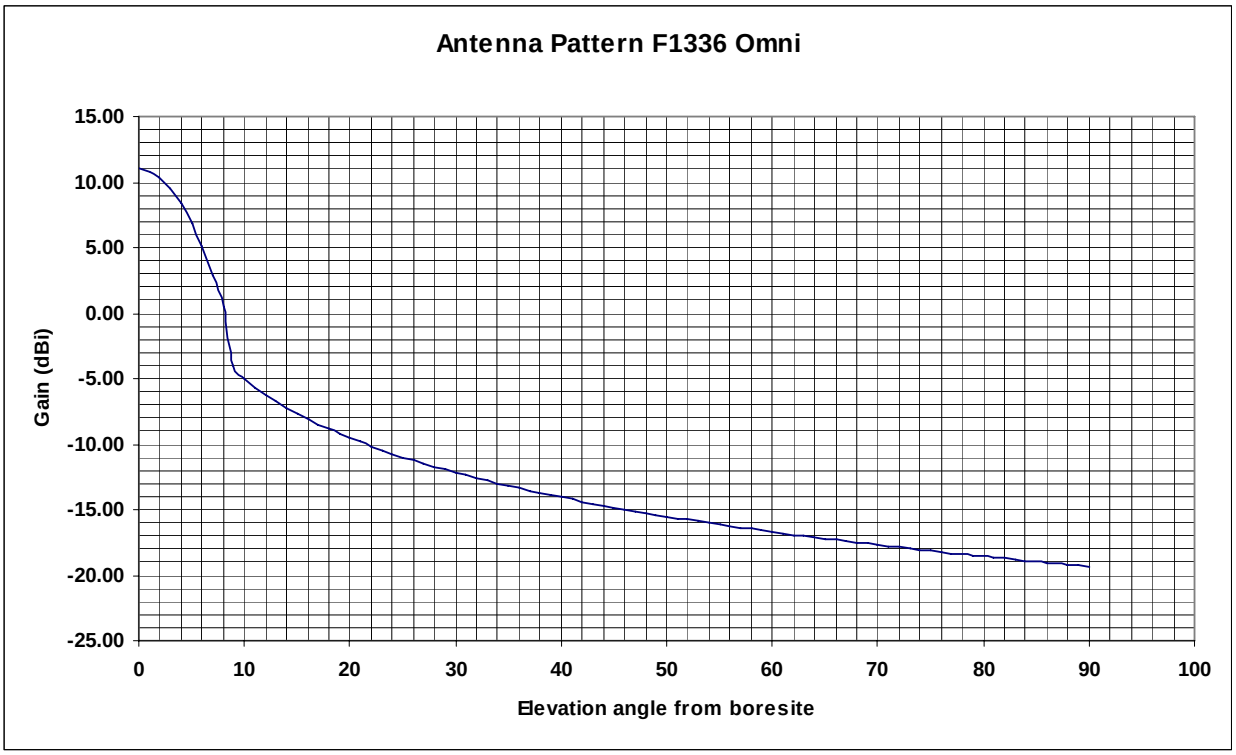


**Figure 1 Omni Antenna Pattern from ITU-R F1336-2**

### 1.1.2 Path Loss

For the purpose of this analysis, three types of path loss environments have been considered; Line of Site (LOS), Non Line of Site (NLOS) and clutter based.

- The approach taken in the LOS category follows the UWB/GPS analysis methodology.[8] The physical model is shown in Figure 2.

[7] RECOMMENDATION ITU-R F.1336-2, Section 2, incorporating recommends 2.2 and 2.4

[8] NTIA Special Publication 01-45**,** Assessment Of Compatibility Between Ultra Wide Band (UWB) Systems And Global Positioning System (GPS) Receivers, Section 3.1.3.

- The NLOS model utilizes the Walfish-Ikegami model which uses a pseudo-physical model shown Figure 3.

- The clutter based approach used the CRC-Predict computer model together with a clutter and terrain database.

The composite path loss was calculated as a function of the variables of interest, namely TX antenna height, Rx antenna height, antenna down-tilt angle, and distance from the transmitter.

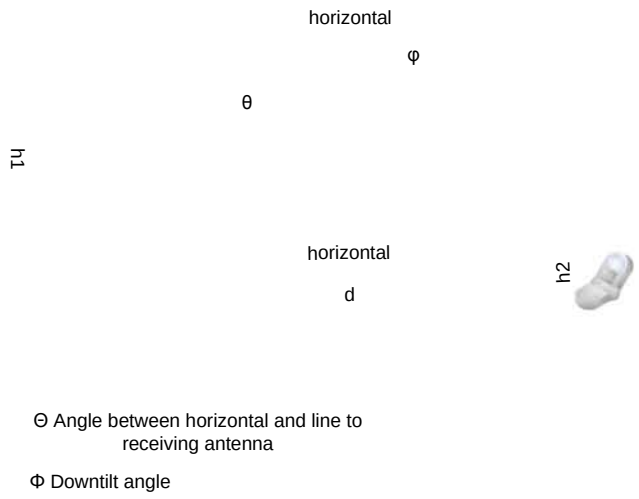


**Figure 2 Physical Model LOS**

| INPUT PARAMETERS (see diagram below) | | | |
|---|---|---|---|
| Frequency in MHz | $f_{MHz}$ | 2326 | Enter these parameters or accept |
| Physical antenna height 1 in m | $h_b$ | 30 | the default values |
| Physical antenna height 2 in m | $h_m$ | 2 | already given. |
| Percentage of buildings | % | 10 | for CCIR model |
| WIM building height | $h_B$ | 5 | for Walfisch-Ikegami non-line-of-sight (NLOS) model |
| WIM building separation | $b$ | 40 | " |
| WIM street width | $w$ | 20 | " |
| WIM angle | phi | 28 | " |
| WIM NLOS environment | | Other | Enter either "Large City" or "Other" (without the quotes) |

**Table 1 Parameters for Walfisch-Ikegami**

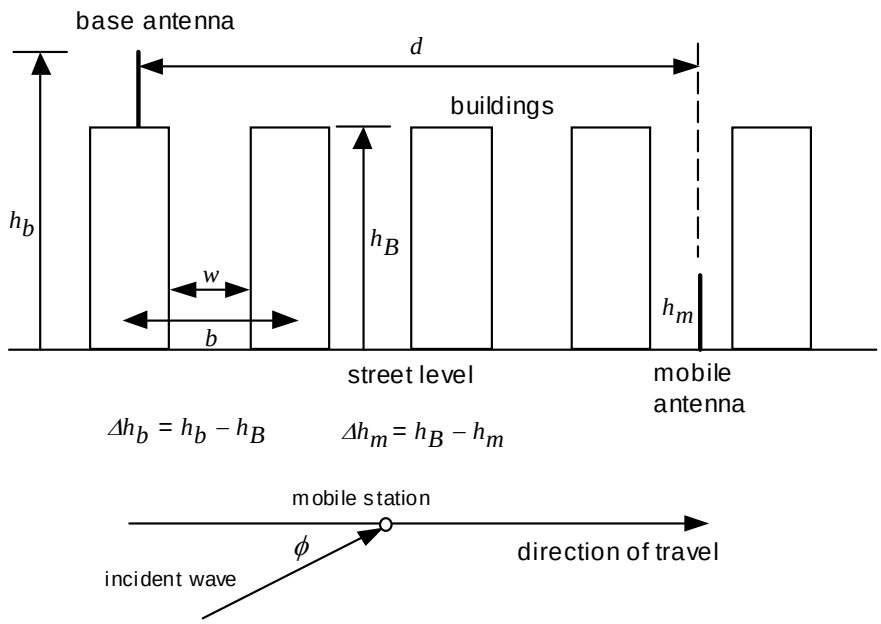


**Figure 3 Physical model for Walfish-Ikegami**

### 1.1.3 Analysis Results

### A. LOS Environment

The results are shown in Figure 4 for the case of no down tilt. These illustrate that in addition to simple EIRP, antenna height, down tilt and the distance within which receiver interference is acceptable need to be specified to estimate the interference potential. Otherwise, up to -30 dBm interference could be received at distances up to 500 meters away from the base station, muting signals from both DARS satellites by a 14 dB margin.

### B. NLOS Environment

The results are shown in Figure 5 for the case of no down tilt. These illustrate that in addition to simple EIRP, antenna height, down tilt and the distance within which receiver interference is

acceptable need to be specified to estimate the interference potential at the receiver's typical operation environments. It should also be noted that the apparent interference potential for this set of assumptions is quite different from the LOS case for exactly the same EIRP and antenna type.

### C. Clutter and Terrain Based

Figure 6 shows a potential base station site in Los Angeles as an example where red illustrates the signal level above -44 dBm for a 15 meter high Omni 2 kW site. The discrete nature of the prediction shape reflects the underlying clutter data resolution of 30 meters. The result shows that the interference impacts the listeners of the satellite radios within four to seven blocks of residential and commercial areas including the nearby highways surrounding this base station, operating at this example height. Also shown are average daily traffic counts for sample points in and around the high signal area. These clearly indicate the large number of vehicles (at a given location, exceeding 26000 on the surrounding streets and 185,000 on the nearby highways) that could potentially be impacted by interference from this example site.

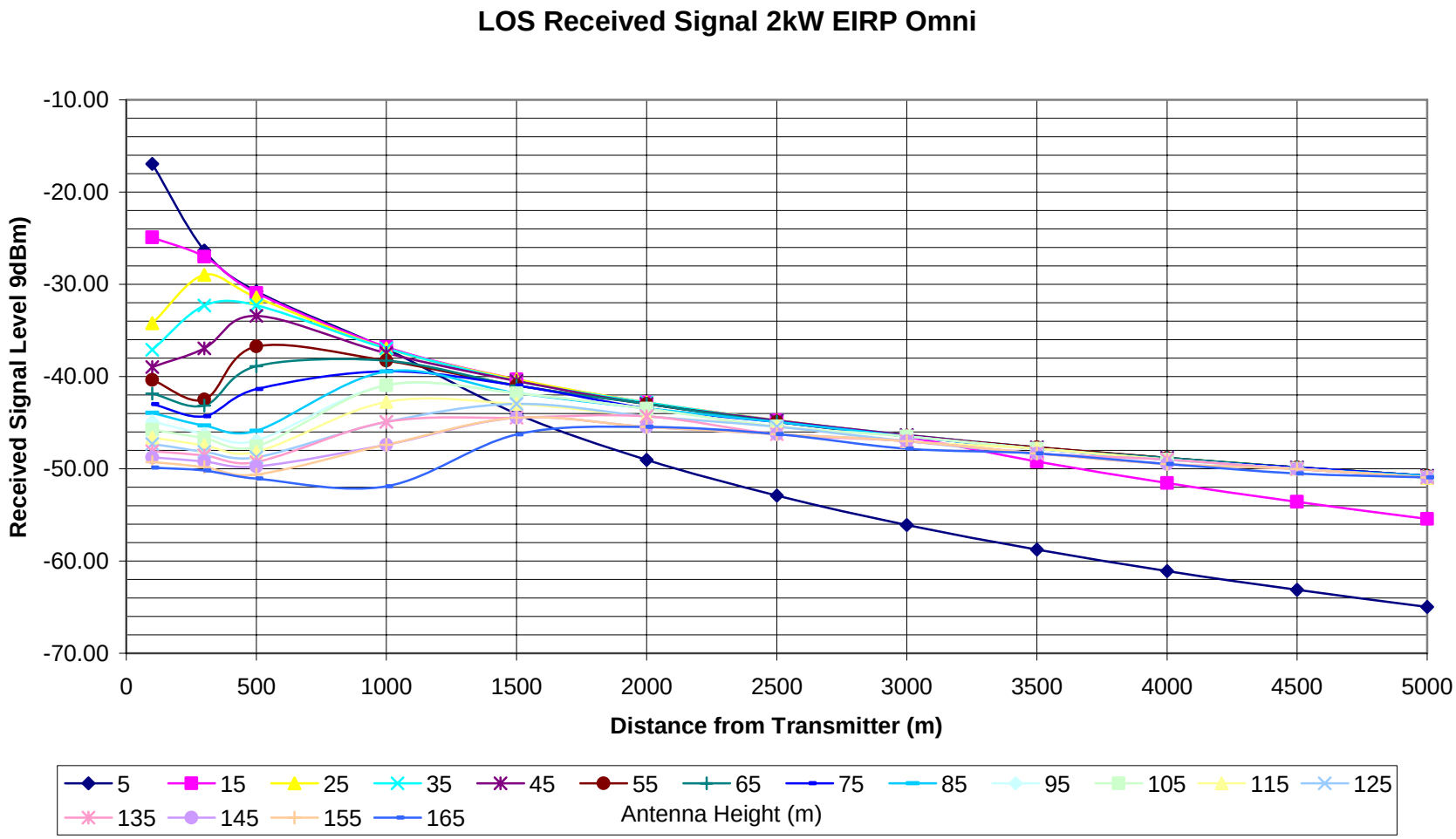


**Figure 4 LOS Received Signal Level**

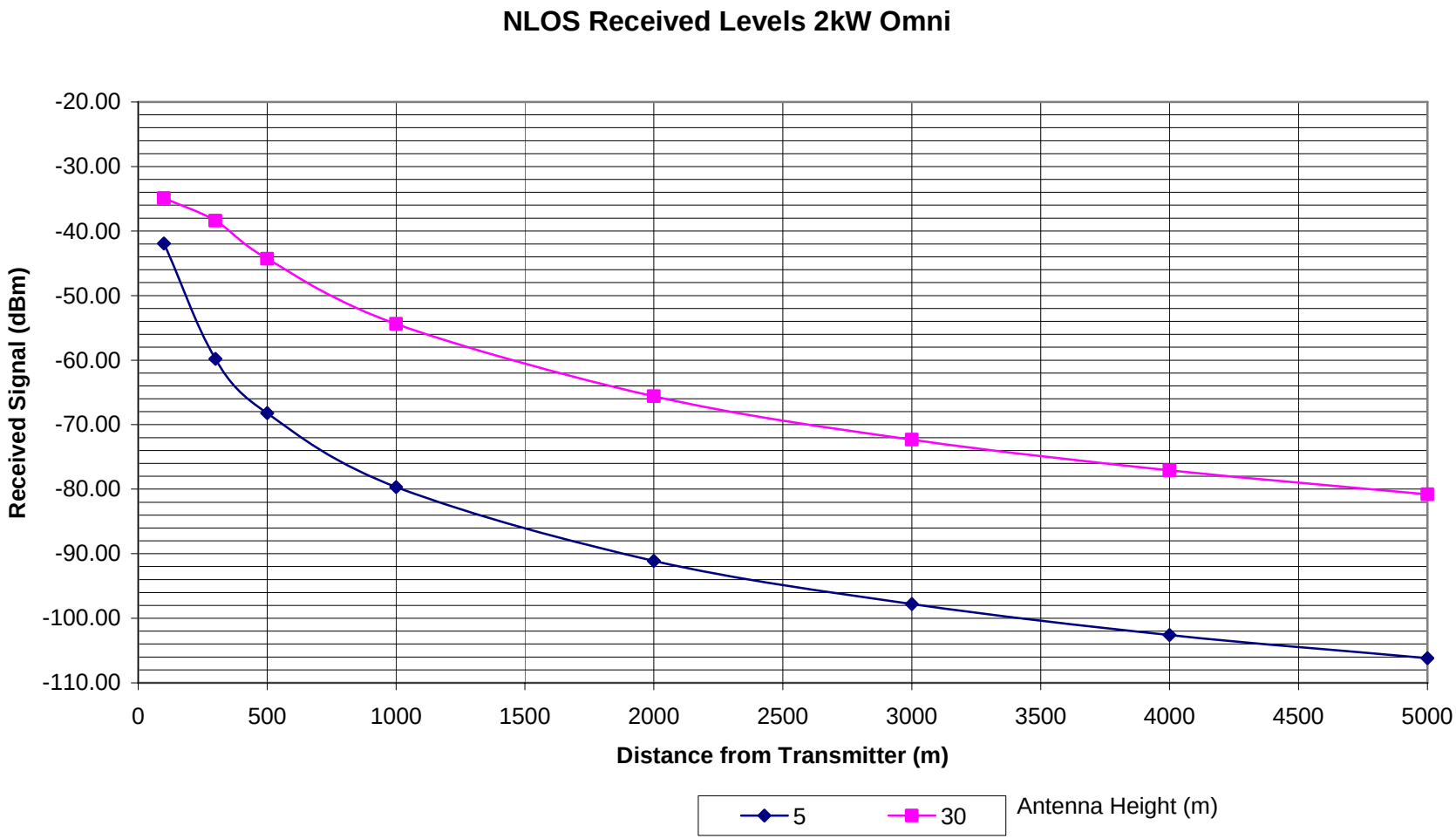


**Figure 5 NLOS Received Levels**

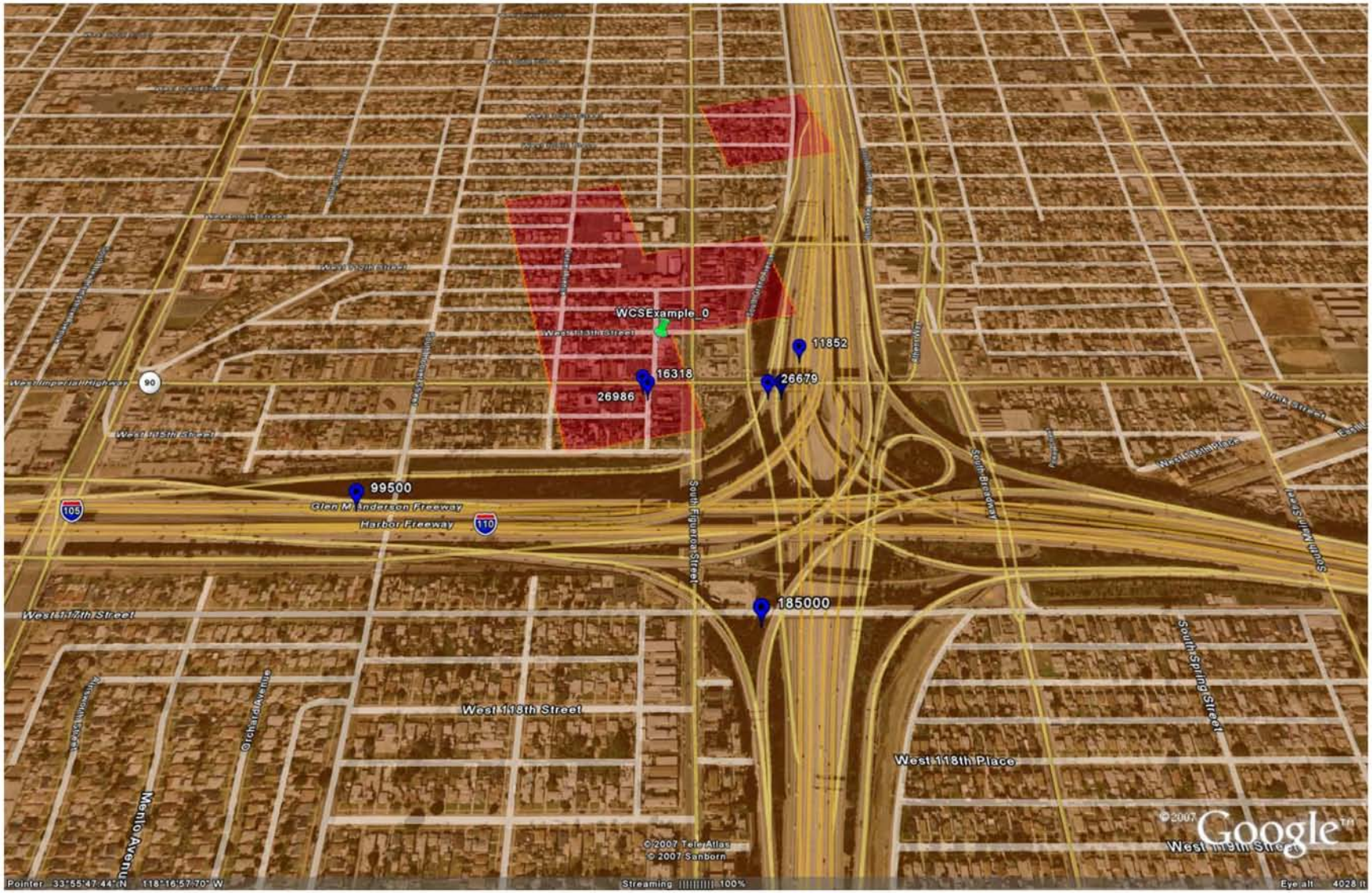


**Figure 6 CRC-Predict 15 m High, 2 kW EIRP Omni, (Los Angeles, CA)**

As a result, the preceding analysis presented the multiple base station design parameters that affect WCS interference into SDARS receivers. Specifically, LOS and NLOS path loss, base station antenna height and down tilt combine to determine the ground-based interference seen at satellite radio receivers. The WCS Coalition's proposed rules do not consider any of these factors, instead relying on unfettered base station operation up to the 2 kW average EIRP limit that will result in significant and uncontrollable variations in the interference to satellite radio receivers.

# ANNEX 3

# Annex 3: The Coalition's Technical Claims Are Unsupported and Based on Inapplicable Precedent

The WCS Coalition ("Coalition") proposal does not provide the technical details necessary to confirm its claims and quotes inapplicable Commission precedent in attempting to support its proposed rule changes. The problems with the WCS Coalition's proposal that cloud a meaningful consideration include:

- *Providing insufficient technical specifications regarding WiMax deployment*: In recent documents,[9] the WCS Coalition has affirmed its intent to adopt Wimax as the technology of choice for their planned service offering in the band. However, the WCS Coalition's proposed rules did not contain a description of the actual WiMax equipment they expect to deploy.[10] Sirius and XM researched operational Wimax equipment to better understand the practical aspects of the potential interference environment parameters, using publicly available information from the Wimax Forum, equipment vendors[11] and FCC type acceptance reports for Wimax equipment in the WCS and 2.5 GHz BRS bands.[12] In Wimax Forum reference link budgets,[13] base station peak EIRP ranged from 28 to 57 dBm (600mW to 500W at extreme ends) – well below the 63 dBm (2000W) average EIRP limit proposed by the WCS Coalition. In the same document, user terminal EIRP limit varied from 14-24 dBm (25-250 mW). FCC type acceptance reports show subscriber equipment EIRP for BRS devices in the 166 to 328 mW range[14] for mobile environments (pedestrian and vehicular). Overall, these published WiMax operating parameters are widely different than the WCS proposal.

- *Providing no interference protection demonstration*: The Commission explicitly stated that requests to waive the out-of-band emission limits "shall be entertained

[9] WCS Coalition Letter at 3 n.7; Reply Comments of the WCS Coalition, WT Dkt No. 06-102, at 13 (June 23, 2006); Consolidated Request for Limited Extension of Deadline for Establishing WCS Compliance with Section 27.14 Substantial Service Requirement, at 10 (Mar. 22, 2006).

[10] In order to allow satellite radio licensees and the Commission itself to analyze and assess the effects of its proposed rules, the agency should require the WCS Coalition to supply more detailed data on their members' proposed deployment.

[11] For instance the FCC Type Acceptance Test Report for Alvarion Base Station BMAX-BST-AU-ODU-HP-2.3 (FCC ID: LKT-BMAX-BA23) the Peak output power with antenna is shown as 53.1 dBm (200W).

[12] The WCS Coalition considers downbanding BRS and/or other frequency equipment for use in the WCS; therefore, performance should be similar. WCS Coalition Letter at 7.

[13] Link budgets contained in *Additional Technical Details Supporting IP-OFDMA as an IMT-2000 Terrestrial Radio Interface*, Document 8F/1079E, Wimax Forum submission to ITU, January 10, 2007, Tables 20-23.

[14] In the BRS band, the EIRP for Mobile Subscriber Modems such as the ZTE ZXMBW-TP25I and Navini PMX are in the 22-25 dBm (.166 to .328 mW) range assuming a 0 dBi antenna.

only if interference protection equivalent to that afforded by the limits is shown."[15] Though the WCS Coalition is not seeking a waiver *per se*, it now seeks to relax the out-of-band emission rules completely without making a demonstration that satellite radio operations will be protected.

- *Not accounting for technical distinctions between the services*: The WCS Coalition's proposal to allow unrestricted deployment of 2000 watt repeaters and base stations imposes identical rules on base station transmitters that were designed to do different things, with nearly opposite service requirements.[16] Satellite radio repeaters offer continuous, broadcast coverage in areas where terrain, obstacles or multipath interference pose challenges to satellite reception. WCS licensees envision periodic two-way traffic in a cellular design, primarily dictated by capacity and coverage requirements. Such disparities invalidate most terrestrial two-way mobile service interference evaluation methodologies in the satellite radio context. Satellite receivers operate with relatively weak satellite signals. Since satellite radio repeaters are "always on" and deployed only where always needed, probabilistic allowances would provide insufficient protection to satellite radio subscribers. Moreover, satellite radio repeater networks are more efficient at higher powers and antenna heights to cover areas unreachable by satellite signals. WiMAX efficiency propels densely deployed small-cell, lower power base networks.

- *Proposing higher mobile output power while claiming to lower it*: The WCS Coalition claims a "substantial reduction" in WCS user unit output power under its proposal, from "the 2000 watts peak EIRP currently permitted to 20 watts average EIRP."[17] But the current Rules specify that mobile transmitters "are limited to 20 watts EIRP peak power," a lower power than that proposed by the WCS Coalition.

- *Importing inapplicable interference models*: The WCS Coalition claims that the MSS ancillary terrestrial services ("ATC") order[18] supports its assumption that "a WCS subscriber generally will not be transmitting in close proximity with an SDARS subscriber, at least not with an unrestricted path between the two."[19] But in that portion of the ATC Order the Commission was considering interference between two land mobile services, not the technically and operationally distinct interference requirements of a continuous broadcast satellite radio service. As highlighted earlier in this section, satellite radio users require continuous reception of the live satellite

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[15] 47 C.F.R. § 27.53(a)(8).

[16] Elsewhere in its petition, the WCS Coalition acknowledges "fundamental differences in the two services." WCS Coalition Letter at 6 n.15.

[17] *Id.* at 9 n. 23.

[18] *Flexibility for Delivery of Commc'ns by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands; Review of the Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Serv. Sys. in the 1.6/2.4 GHz Bands*, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd 1962 (2003) ("*MSS/ATC Order*").

[19] WCS Coalition Letter at 12.

signal. Interference from a nearby WCS user is much more likely to directly affect satellite radio reception, whereas a victim land mobile terminal is much less likely to be in an active session when the interference conditions occur.

- *Assuming an unsupported minimum separation distance*: The WCS Coalition claims that the FCC has held that in most cases a WCS subscriber will not be transmitting within 12 feet of a satellite radio receiver.[20] This claim does not account for the potentially common situation where a particular user subscribes to both services and attempts to operate the two devices in close proximity, or where WCS devices on nearby pedestrians or in nearby vehicles are operating.
- *Mistakenly applying the specific to the general*: The FCC's 12 foot assumption was based on the particular low power system (likely to be operated indoors) proposed by PPF/Digivox,[21] which, in turn, assumed a 200 mW mobile transmitter and an 800 mW base station with a 12.5 percent duty cycle.[22] These low power levels suggest a local area network implementation, not a wide area implementation such as WiMAX commercial mobile broadband service. In any event, the FCC already considered low-power portables and already relaxed out-of-band limits for such units—to 93 + 10 log (p), which is 25-38 dB more protective than what the WCS Coalition proposes to apply to WCS mobile devices operating with up to 2 watts.
- *Selectively relying on the WCS reconsideration order*: Citing the *WCS MO&O*, the WCS Coalition correctly reiterates that the agency's WCS allocation decision allowed for the possibility of accommodating out-of-band emissions that exceed the limit in Section 27.53.[23] And the Coalition reprints the following sentences, which consider mitigation via "reduced gain in the direction of Satellite DARS receiver" or implementations that inherently reduce "the probability of the transmitters of a certain type of WCS system being close enough to interfere with Satellite DARS systems." The WCS Coalition, however, provides very few system specifics and predicts antenna discrimination between a transmitting WCS mobile unit and a satellite radio receiver that likely does not exist. Because satellite radio operates in a multipath

[20] *Id.* at 11-13.

[21] In particular, the FCC found that "PPF/DigiVox has provided a specific set of operating parameters that we can take into account in our analysis of potential interference to DARS. By taking these specific parameters into account, we believe it is possible for a system to operate with less stringent out-of-band limits than those originally adopted." *Amendment of the Comm'n's Rules to Establish Part 27, the Wireless Commc'ns Serv.*, Memorandum Opinion and Order, 12 FCC Rcd 3977, 3991 (¶ 26) (1997).

[22] 47 C.F.R. § 27.52(a)(9).

[23] WCS Coalition Letter at 6-11. The fact that the Commission allowed for the possibility of accommodating out-of-band emissions that exceed the rules is not, in itself, meaningful. As the Supreme Court has held, "well established that an agency's authority to proceed in a complex area. . . by means of rules of general application entails a concomitant authority to provide exemption procedures in order to allow for special circumstances." *United States v. Allegheny-Ludlum Steel Corp.*, 406 U.S. 742, 755 (U.S. 1972). Such a process would remain available under the rules proposed by Sirius.

environment, polarization or angular discrimination cannot be relied on for reducing interference.[24]

- *Relying too much on satellite radio buffers*: The WCS Coalition asserts that blockage from WCS user transmissions will "likely be of a shorter duration than the buffer capacity" already built into satellite radio receivers,[25] although the WCS Coalition provides no traffic analysis of WCS mobile signals. The WCS Coalition also does not take into account the facts that the satellite radio system design aspects were established after the 2.3 GHz license assignment based on the understanding of the operation of the WCS systems complying with the current coordination rules, and the satellite radio buffers were designed primarily to recover the weak satellite signals in the presence of highly challenging user operational environments to achieve the targeted quality of service levels, not to undo unknown WCS interference.

- *Using unsupported assumptions about power control*: The WCS Coalition relies on WCS power control to reduce interference to satellite radio receivers.[26] Even utilizing transmitting power control, however, the WCS Coalition's proposed rules for mobile operations would still result in significant interference to satellite radio receivers, including during the periods when they are operating 5 dB below maximum authorized power.[27] The WCS Coalition did not offer a supporting analysis for this issue, and the resulting power control effect may be less on average than 5 dB depending upon the network implementation details. It is also clear that the power control is a function of distance and operational environment. Near the outer range of a cell site containing the significant portion of a cell area, the power control effect would be effectively zero as the mobile user terminal attempts to close up the link by transmitting at or near the maximum power levels. In dense urban locations, the power control effect would be near zero even at closer distances to the base station as the user terminal attempts to close up the link thru urban clutter by transmitting near the maximum levels. As a result, the theoretical assumption of relying on power control to mitigate interference effects to satellite radio receivers would not be applicable throughout much of the cell area.

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[24] WCS Coalition Letter at 12-13.

[25] *Id.*at 12.

[26] *Id.* at 11, 12-13.

[27] *Id.*at 11.