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ATTORNEYS AT LAW

February 20, 2001

BY ELECTRONIC FILING

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
The Portals
445 Twelfth Street, S.W.
Washington, DC 20554

Re: ***Ex Parte Presentation***
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

Dear Ms. Salas:

AT&T Wireless Services, Inc. ("ATTWS") is the licensee of, or holds direct control over, more than 40 of the Wireless Communications Service ("WCS") licenses auctioned by the Commission in April 1997. It is in the process of deploying its WCS network to implement Project Angel, which will provide new facilities-based competition in both the local exchange market and the broadband Internet access market. Commercial service is slated to begin within the next several weeks. But just as ATTWS is poised to roll out this exciting new service, it is faced with the threat that the Commission might authorize satellite Digital Audio Radio Service ("SDARS") licensees to deploy a large number of very high power terrestrial repeaters (up to 40 kW) without regard to or prior coordination with any WCS operations.

The deployment of repeaters operating at such high power is not necessary: even the SDARS licensees admit that they could achieve the same results using standard power repeaters operating at power levels of 2 kW and below. As demonstrated in the technical exhibit attached hereto, deployment of high power SDARS repeaters could have disastrous consequences for Project Angel and severely compromise the utility and value of ATTWS' WCS licenses – potentially excluding over 30,000,000 households, or approximately 30% of the U.S., from being served by ATTWS. Simply put, there is no way that ATTWS or any other WCS licensee could be expected to roll out a service while subject to the uncertainty that SDARS licensees may, at

Magalie Roman Salas
February 20, 2001
Page 2

any time, deploy high power repeaters without any restriction as to location, prior coordination, or other spectrum management process.¹

To be clear, ATTWS does not begrudge SDARS a terrestrial component and would welcome the opportunity to work with the SDARS licensees in an effort to coordinate high power repeaters. ATTWS' service will not compete with SDARS, and so ATTWS has no economic incentive to stymie the SDARS service. Nonetheless, ATTWS cannot acquiesce to an open-ended repeater regime that will perpetually threaten its ability to use WCS spectrum to provide a valuable new competitive local service.

Accordingly, ATTWS submits that the Commission should not grant the unprecedented blanket license for high power repeaters that the SDARS licensees have requested; rather, it should adopt a blanket authorization for standard power transmitters -- operating under the same maximum power levels applicable to WCS -- with a notice requirement. Any high power repeaters should be coordinated with all affected WCS licensees on a site-by-site basis before licensing. Such a regime will achieve an appropriate balance by protecting the integrity of the WCS licenses while still affording the SDARS licensees substantial flexibility in deploying their repeater networks.

BACKGROUND

A. *Project Angel*

ATTWS's WCS licenses span both the entire geography of the United States as well as all four frequency blocks of the WCS service. It is in the process of implementing Project Angel, an ambitious series of wireless networks which will comprise the fundamental infrastructure for its Digital Broadband fixed wireless service and provide "last mile" connectivity, mainly to residential and small business customers. With a single Remote Unit ("RU"), a customer will have an instant wireless local area network and the ability to use up to five computers (all online) and four phone lines simultaneously, with data rates as high as 1 Mbps. Thus, this next-generation service will promote two important Commission goals: additional facilities-based competition in the local exchange market and a competitive alternative for broadband Internet access. ATTWS is currently deploying its WCS networks in a number of cities (including Los Angeles, Houston, and Anchorage) and has been testing its equipment under an experimental license granted in June 2000.

ATTWS designed its WCS equipment based on the interference environment anticipated under the Commission's rules currently in effect, which include the limit on all fixed WCS transmitters of no more than 2 kW peak equivalent isotropically radiated power ("EIRP").² A similar EIRP limit applies in the Multipoint Distribution Service and the Instructional Television

¹ The SDARS licensees have proposed an out-of-band emissions limitation of $75 + 10 \log(p)$ dB (where p is the EIRP in watts) less than the transmitter EIRP. This limitation is acceptably stringent as far as it goes, but it does not address the overload and rejection problems presented by the proposed high power repeaters.

² See 47 C.F.R. § 27.50(a).

Magalie Roman Salas
February 20, 2001
Page 3

Fixed Service, the two commercial wireless terrestrial services that use nearby spectrum.³ Because the WCS spectrum surrounds the SDARS spectrum, ATTWS is understandably concerned by the SDARS licensees' request to use adjacent frequencies at a power level twenty times higher than its own and without any requirements for coordination.

Given the likelihood that the combined deployment of WCS and SDARS networks will worsen the interference environment, ATTWS has recently explored the possibility of redesigning its WCS equipment in order to make it more resistant to overload. This effort has required substantial engineering resources and the additional filtering required in the redesigned equipment inevitably will make it more expensive than the current equipment. Nonetheless, ATTWS has voluntarily undertaken this process in order to make the sharing environment more hospitable for all spectrum users. Unfortunately, that process has not yet come to fruition, and even once the design work is completed no equipment will be ready to deploy for another nine to twelve months thereafter. Thus, at least for the remainder of this year ATTWS will be able to deploy only its current WCS equipment. Accordingly, the analysis presented herein relates to the current specifications.⁴

B. The History of SDARS Repeaters

Neither of the two SDARS licensees, XM Radio and Sirius, is at present authorized to operate any terrestrial repeaters on a commercial basis.⁵ However, they have consistently maintained that they would need to supplement their satellite network with terrestrial "gap-fillers" to be used in urban canyons, under bridges, in high mountain passes, in tunnels, and in other areas where it may be difficult to receive SDARS signals transmitted by satellite. Yet the operational characteristics of such repeaters had not been quantified prior to the WCS auction in April 1997. Moreover, until very recently the SDARS licensees' proposals had not indicated a willingness to accept *any* restriction on the number of such repeaters, nor on the power, location, height, or antenna characteristics with which such repeaters would be allowed to operate.⁶ ***Such blank check authority to deploy without limitation would be truly extraordinary.***

From the record in this proceeding, it would appear that the SDARS licensees intend to deploy a total of approximately 255 repeaters nationwide with an EIRP greater than 2 kW – 150 for XM Radio and 105 for Sirius. However, this quantification has been subject to "number

³ See *id.* at §§ 21.904, 74.935.

⁴ In assessing the impact of SDARS repeaters on the WCS service, the Commission should not concentrate only on the attributes of equipment being deployed by ATTWS and Metricom. The WCS rules anticipate flexible use of the band, and the Commission should not adopt rules in this proceeding that would effectively foreclose certain services.

⁵ To the extent that SDARS repeaters have been deployed pursuant to experimental authorizations, such authorizations cannot be used for commercial service and indicate no conclusion on the part of the Commission that the licensee will ever be authorized to operate on anything more than an experimental basis. See 47 C.F.R. § 5.83; FCC Form 442, Item 23(d).

⁶ See *Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band*, 12 FCC Rcd. 5754, 5845 (1997) (rule proposed by Sirius) ("*SDARS NPRM*"); Comments of CD Radio, IB Docket No. 95-91 at p. 7 (June 13, 1997) (proposed revision to proposed rule).

Magalie Roman Salas
February 20, 2001
Page 4

creep.” When the idea was first introduced, terrestrial repeaters were to be used as gap-fillers only. In its December 17, 1999 Supplement, XM Radio indicated its intent to deploy and operate approximately 1500 repeaters nationwide, including 150 high power repeaters with EIRP ranging from 3 kW to 20 kW per carrier.⁷ Yet at a January 11, 2001 meeting, XM Radio representatives handed out a fact sheet indicating that 25 of its repeaters would operate at greater than 20 kW, up to a maximum of 31.7 kW. Similarly, in a November 1997 filing, Sirius indicated that it would deploy 600 to 800 passive repeaters and 100-150 active repeaters with EIRPs varying from about 12 kW to 25 kW.⁸ In a January 2000 submission, Sirius specified that it anticipates a need for about 105 high power sites in approximately 46 cities.⁹ But Sirius’ most recent submission to the Commission strongly indicates that the 105 high power repeaters currently requested would be only the start of its high power deployment. The rule proposed on January 25 would give the SDARS licensees *the absolute right to deploy at least 1150 repeaters with EIRP of up to 40,000 watts without any requirement for coordination with, and regardless of the impact upon, other wireless operators.*¹⁰ At this level, the SDARS repeaters would have the power of a mid-sized FM or large AM radio station and cover up to 150 square miles each – with some cities requiring as many as 30 high power repeaters.¹¹ Apparently, the gaps to be filled in the satellite service now encompass entire metropolitan areas.

C. *Recent Developments*

On January 11, 2001, representatives of XM Radio, Sirius, and several WCS licensees met with staff from the International, Wireless Telecommunications, and Mass Media Bureaus and the Office of Engineering and Technology to explore the parameters of blanketing interference into WCS operations from the use of high power terrestrial repeaters by the SDARS licensees. In response to staff requests at that meeting, (1) the WCS licensees submitted a letter confirming their view that high power repeaters would cause an unacceptable level of interference even as compared to deployment of a greater number of standard power repeaters; and (2) the SDARS licensees submitted a proposed rule that would grant a blanket license for over 1100 high power terrestrial repeaters. On February 5, 2001, Sirius submitted a letter that purports to demonstrate – without including any underlying assumptions or calculations -- that WCS licensees should prefer high power repeaters to standard power repeaters. It does not even

⁷ See Supplemental Comments of XM Radio Inc., IB Docket No. 95-91 at p. 3 (Dec. 17, 1999).

⁸ See Letter to Rosalee Chiara from Robert D. Briskman, dated November 14, 1997, at pp. 4-5 (“Sirius 11/14/97 Letter”).

⁹ Supplemental Comments of Sirius Satellite Radio, IB Docket No. 95-91 at Exhibit 4, p. 3 (Jan. 18, 2000) (“Sirius Supp.”).

¹⁰ Under Section 25.144(e)(3)(ii) of the proposed rule, each licensee is entitled to deploy 175 repeaters plus at least two additional high power repeaters in each of 176 Basic Economic Areas plus up to 50 additional high power repeaters nationwide, for a total of 577 each or 1154 combined. See Letter to Magalie Roman Salas from Carl R. Frank, dated Jan. 24, 2001 (“Sirius 1/24/01 Letter”).

¹¹ See Sirius 11/14/97 Letter at p. 5 (projecting repeater service areas with 5-7 mile radius and 10 repeaters in New York); Sirius Supp. at Exhibit 4, p. 6 (top ten markets will require several high power repeaters each). At the January 11 meeting, XM Radio indicated that it would deploy 30 high power repeaters in Boston, 20 in New York, and four in Chicago.

Magalie Roman Salas
February 20, 2001
Page 5

attempt to explain what motivation the WCS licensees would have – other than responsible spectrum management – to reach a contrary conclusion, as they have.

In the period since the January 11 meeting, ATTWS' engineers have analyzed the available data in an attempt to determine the impact of high-powered SDARS repeaters on the planned broadband WCS service. Unfortunately, these efforts have been hampered by a paucity of available data on the location and basic operational characteristics of each planned repeater, except in a small handful of cities.¹² ATTWS has reviewed all of the filings made by the SDARS licensees in this proceeding that discuss their terrestrial repeater networks. Until the February 5 letter, those submissions focused on the impact of high power repeaters on MDS/ITFS operations or on out-of-band emission limits (which ATTWS agrees are adequate). And even Sirius' recent submission sheds little light on the impact of high power repeaters on the kind of last mile voice and data service that ATTWS has spent the last several years developing and is now in the process of rolling out. Without basic information on the location, height, and power of specific repeaters in specific cities, it is impossible for ATTWS to perform the kind of analysis that would enable it to conclude – as it would like to -- that its operations could be coordinated with the high power repeaters planned in any given market.

DISCUSSION

Simply put, there is no way that ATTWS or any other WCS licensee can roll out a service if SDARS licensees are authorized to deploy a large number of high power repeaters -- both now and especially in the future -- without any prior coordination or other spectrum management process. The prospect that ATTWS could deploy its equipment, amass a customer base, and then lose the ability to continue serving thousands of existing customers at a time through the unilateral action of an SDARS licensee would seriously undermine the viability of Project Angel.

A. *Technical Analysis*

The technical appendix attached hereto demonstrates the comparative impact of high power repeaters and standard power repeaters on ATTWS' WCS equipment. For purposes of this analysis, ATTWS has calculated the area in which an SDARS repeater would degrade service to an unacceptable level. The appendix analyzes the affect on both the WCS base stations and RUs. As mentioned above, ATTWS has undertaken – at considerable time and expense – to redesign its WCS equipment to achieve a more robust service offering. That effort is not yet completed, so the attached analysis relates to equipment currently being deployed. ATTWS hopes that a new design will improve the sharing environment. However, there is no practical way to completely counteract the blanketing interference that would be caused by a terrestrial repeater operating at as much as 40 kW EIRP, and thus the SDARS high power repeaters will continue to have a significant deleterious effect on Project Angel.

¹² Both XM Radio and Sirius have provided data on Boston, Atlanta, and San Francisco. Sirius has also provided data for Houston and New York.

Magalie Roman Salas
February 20, 2001
Page 6

As demonstrated in the technical appendix hereto, a high power SDARS repeater would create an area of blanketing interference with a radius of approximately 11.5 km for base stations and 4.85 km for RUs. ATTWS would only be able to provide a degraded level of service from any base station within an exclusion zone of about 415 km² or to any RU within a 74 km² area surrounding a high power SDARS repeater. Such degraded service, of course, is unacceptable in the provision of a lifeline offering. By contrast, a standard power SDARS repeater would create an exclusion zone with a radius of 2.6 km for base stations and 1.65 km for RUs, decreasing the size of the affected area to approximately 21 km² for base stations and 8.6 km² for RUs. *That is, the blanketing interference would be approximately 8.5 times worse for customer units and 19.5 times worse for base stations with high power repeaters.* Assuming that each high power repeater would have to be replaced by five standard 2 kW repeaters,¹³ there is no question that ATTWS would prefer – if that is an appropriate characterization – to lose a combined 105 km² service area than a single 415 km² service area.

One measure of the impact of these exclusion zones is the number of households that ATTWS would be precluded from serving. Applying a representative urban household density to the base station exclusion zone calculated in the attached technical analysis indicates that a 40 kW SDARS repeater would degrade service to over 218,000 households. Using Sirius' deployment projection of at least one repeater in each of the top 46 markets, this would preclude service to over 10 million households. This number does not include any additional households that would be covered by XM Radio's high power repeaters. Moreover, it undercounts households in cities requiring multiple high power repeaters, such as Boston, New York, and Chicago. And if the rule proposed by Sirius were adopted, each SDARS licensee would be allowed to deploy at least two additional high power repeaters per city, which would increase the total households potentially affected to over 30 million – or approximately 30% of the households in this country.¹⁴

The "analysis" submitted by Sirius on February 5 does not undercut these conclusions.¹⁵ First, there is virtually no explanation of the assumptions, data, or methodology used to reach its conclusions. Second, the one aspect of the analysis that is defined – a -35 dBm signal strength sensitivity threshold – would preclude the Project Angel service. The actual signal strength threshold for ATTWS' WCS equipment is approximately -45.1 dBm for the base station and -58.6 dBm for the RUs.¹⁶ The Sirius charts do not show signal contours at these levels.

¹³ See Consolidated Reply of XM Radio, Inc., IB Docket No. 95-91 at p. 14 (Mar. 8, 2000). Sirius essentially agreed with this estimate at the January 11 meeting, but in its February 5 submission it indicated that it would need 13 standard repeaters to replace a single high power repeater. See Letter to Magalie Roman Salas from Carl Frank, dated Feb. 5, 2001, at p. 3 ("Sirius 2/5/01 Letter"). ATTWS' own analysis would tend to confirm the XM Radio estimate.

¹⁴ According to the most recent census data available, there were approximately 101 million households in the United States in July 1998. See Appendix A at p. 4.

¹⁵ See generally Sirius 2/5/01 Letter.

¹⁶ As indicated in the attached analysis, these calculations are based on a repeater spreading 40 kW over 5 MHz of spectrum, even though we understand that Sirius intends to use only 4 MHz of spectrum for its terrestrial operations. Obviously, calculations based on a 4 MHz case would demonstrate greater interference.

Magalie Roman Salas
February 20, 2001
Page 7

Moreover, the Sirius analysis does not even purport to assess the impact of the *multiple high power repeaters in each market* that would be allowed under its proposed rule.

B. Proposed SDARS Repeater Authorization Regime

It may be, given demographic and geographic variations, that most or all of the exclusion zone of a high power SDARS repeater in a given market would fall upon an area in which WCS licensees do not intend to provide service. In that case, the impact of a single high power repeater might be preferable to that of multiple replacement standard power repeaters. Without knowledge of the location and basic operating parameters of the SDARS repeaters in advance, there is no way for ATTWS to make this determination or to design its system to mitigate any interference that would be created. Moreover, ATTWS cannot deploy a system if the Commission's rules would place it in constant peril of having a lifeline service within a substantial coverage area wiped out by unilateral high power repeater deployment in the future.

Given these realities, ATTWS believes that the default rule should limit SDARS repeaters to no more than 400 W/MHz maximum EIRP – the limit under which all other commercial terrestrial services in nearby bands (*i.e.*, WCS, MDS, and ITFS) operate – with a process for determining whether high power deployment could be coordinated in specific cases. The Commission has noted that requiring a separate authorization for each terrestrial repeater would impose a burden on both the Commission and its SDARS licensees.¹⁷ The approach proposed by ATTWS would eliminate specific licensing for all those SDARS repeaters operating at or under 400 W/MHz EIRP, which comprise the vast majority of repeaters. Given the limited number of high-power repeaters requested to date by the SDARS licensees – 150 by XM Radio and 105 by Sirius – processing these site applications should not impose an undue burden. Moreover, to the extent that future developments call for adjustments in the repeater network, the SDARS licensees will be able to respond either by deploying standard power repeaters immediately or by seeking site licenses for additional high power repeaters, or through a combination of these two approaches. And as the Commission previously found in this band, setting maximum power limits will provide equipment manufacturers and service providers with the necessary certainty regarding the potential interference environment to enable them to design and purchase more robust equipment – just as ATTWS is currently doing.¹⁸

Both SDARS licensees have opposed any licensing requirement. XM Radio has analogized the use of terrestrial repeaters in the SDARS service to the use of booster stations in the broadcast services – which are unlicensed -- going so far as to assert that “it is difficult to justify disparate treatment.”¹⁹ But FM booster stations may not operate at an effective radiated power (“ERP”) that is more than 20% of the primary station’s ERP and must provide protection from interference to first-adjacent channel stations.²⁰ XM Radio does not propose to subject its

¹⁷ SDARS NPRM, 12 FCC Rcd. at 5812.

¹⁸ Amendment of the Commission's Rules to Establish Part 27, the Wireless Communications Service, 12 FCC Rcd. 3977, 3983-84 (1997) (“WCS Service Order”).

¹⁹ See Reply Comments of American Mobile Radio Corp., IB Docket No. 95-91 at p. 21 (filed Oct. 13, 1995).

²⁰ See 47 C.F.R. §§ 74.1235(c), 74.1204(g).

Magalie Roman Salas
February 20, 2001
Page 8

repeaters to comparable constraints. In a similar way, Sirius has repeatedly asserted that the Commission should refrain from requiring individual licensing for SDARS repeaters just as it has done for repeater and booster stations in other services.²¹ Yet in advocating this approach, Sirius totally ignores the other factors that allowed the Commission to adopt a blanket licensing approach in those other services. For example, in both the private land mobile service and the private fixed microwave service rules cited by Sirius, additional transmitters are limited to a maximum ERP of five watts and operators are explicitly responsible for correcting any harmful interference they cause to other systems.²² The public mobile radio service requires pre-coordination and “[I]icensees must not allow any signal booster that they operate to cause interference to the service or operation of any other authorized stations or systems.”²³ And the Commission found that individual licensing of signal boosters in the land mobile radio and paging services would be “burdensome and unnecessary” because they “only fill in weak or no-signal areas” and the low transmitting power minimizes the potential for interference.²⁴ If SDARS repeaters similarly were required to (1) operate at a reasonable power level, (2) pre-coordinate with other systems, and (3) correct any harmful interference that results, the Commission would similarly be able to authorize them on a blanket license basis. Those circumstances clearly do not apply to the use of high power repeaters under any rule proposed to date by the SDARS licensees.

It is also worth pointing out that, even with a 400 W/MHz limitation, not only will SDARS repeaters interfere with WCS receivers, but WCS transmitters will interfere with both SDARS receivers and other WCS receivers. Without some sort of mechanism for coordination, this interference environment would be unhealthy for every service provider in the band. Accordingly, ATTWS believes that the Commission should also adopt a policy for standard power SDARS repeaters similar to the one applicable to standard power WCS transmitters. Specifically, SDARS licensees should be required, at least 30 days before commencing operations from any new repeater site or with increased power from any existing repeater site, notify all WCS licensees in or through whose licensed service areas they intend to operate of the technical parameters of the repeater facility, with licensees of both services expected thereafter to coordinate in good faith to avoid interference problems and to allow the greatest operational flexibility in each other’s operations.²⁵ Although it is outside the scope of the current proceeding, ATTWS believes that it would also be in everyone’s interest to go even further and agree upon reciprocal intra- and inter-service notification and coordination procedures that will optimize the overall performance of all WCS and SDARS systems without imposing too great an administrative burden.

²¹ See, e.g., Reply Comments of CD Radio, IB Docket No. 95-91 at p. 4 (Jan. 21, 1998); Reply Comments of CD Radio, IB Docket No. 95-91 at pp. 3-4 (June 27, 1997).

²² See 47 C.F.R. §§ 90.219, 101.151.

²³ *Id.* at §§ 22.150, 22.527.

²⁴ See *Routine Use of Signal Boosters*, 11 FCC Rcd. 16621, 16631 (1996).

²⁵ See 47 C.F.R. § 27.58(e); *WCS Service Order*, 12 FCC Rcd. at 3985.

CONCLUSION

ATTWS understands the need for a flexible approach to SDARS repeater licensing that will accommodate unforeseen events with the least amount of regulatory oversight consistent with sound spectrum management. Accordingly, ATTWS has proposed a rule that would allow SDARS licensees to deploy repeaters operating at up to 400 W/MHz EIRP subject only to a prior notification and good faith coordination requirement. That should be sufficient to solve any problem that arises, since the SDARS licensees themselves admit that several standard power receivers can be used to cover the area served by a single high power repeater. Only to the extent that an SDARS licensee seeks to deploy a high power repeater would it be required to obtain prior, site-specific authorization from the Commission.

ATTWS has no interest in stymieing the SDARS service. Its use of WCS spectrum to provide broadband and telephone services will not compete with the digital radio services of XM Radio and Sirius. Accordingly, there is no reason to believe that the concerns raised by ATTWS arise out of anything but legitimate spectrum sharing issues.²⁶ Both WCS licensees and SDARS licensees paid for their spectrum – and neither should be required to bear all of the burden to accommodate the other. The rules proposed by the SDARS licensees would essentially expropriate the WCS spectrum through SDARS use. Having chosen not to bid in the WCS auction, the SDARS licensees should not now be allowed unilaterally to compromise spectrum that they saw fit not to acquire.²⁷

²⁶ In the past, the SDARS licensees have intimated that opposition to their terrestrial repeater networks by the National Association of Broadcasters was inspired more by an anticompetitive “protectionist agenda” than by concern for spectrum management. *See, e.g.*, Reply Comments of CD Radio, IB Docket No. 95-91 at p. 2 (Jan. 21, 1998).

²⁷ The Commission actually invited SDARS licensees to participate in the WCS auction and made clear that WCS spectrum could be used for terrestrial repeaters. *See SDARS Service Order*, 12 FCC Rcd. 5754, 5776 (1997); *WCS Service Order*, 12 FCC Rcd. at 10800 n.70.

Magalie Roman Salas
February 20, 2001
Page 10

Spectrum sharing is not always easy, but as congestion increases sharing becomes increasingly critical. The proposal put forth herein is a reasonable accommodation that allows SDARS operators to deploy the bulk of their terrestrial repeater networks without further authorization and the ability to seek authorization for the remaining elements in a process that nonetheless mitigates harm to adjacent spectrum users. No Commission licensee can expect more than that.

Respectfully submitted,

/s/

William M. Wiltshire
Karen L. Gulick
Counsel for AT&T Wireless Services, Inc.

Attachment

cc: Chris Murphy
Ron Repasi
Rosalee Chiara
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APPENDIX A: TECHNICAL ANALYSIS

INTERFERENCE EFFECTS OF STANDARD AND HIGH POWER SDARS REPEATERS ON AT&T WIRELESS FIXED WIRELESS SERVICE BASE STATION AND REMOTE UNITS

Interference Source	Transmit Height, Meters	Radiated Sensitivity, dBm in 5 MHz	Required Path Loss, dB	Exclusion Radius, km	Households Affected
Standard Power SDARS Repeater to FWS Base (63 dBm in 5 MHz)	200	-45.1	108.1	2.600	11,150
High Power SDARS Repeater to FWS Base (76 dBm in 5 MHz)	200	-45.1	121.1	11.500	218,125
Standard Power SDARS Repeater to RU (63 dBm in 5 MHz)	200	-58.6	121.6	1.650	4,490
High Power SDARS Repeater to RU (76 dBm in 5 MHz)	200	-58.6	134.6	4.850	38,797

The chart above summarizes the exclusion effects of both standard and high power SDARS terrestrial repeaters on the AT&T Wireless fixed wireless service (“FWS”) using WCS spectrum. Assuming that an increase of 1 dB in the noise floor of a WCS receiver is the limit for unacceptable degradation of the receiver's performance, we determine the maximum interference from standard and high power SDARS transmitters that can be tolerated by FWS base stations and FWS RUs. Using an appropriate path loss equation, the maximum tolerable interference and the SDARS and FWS operating parameters are then used to calculate the required separation distances between SDARS repeaters and FWS receivers. These separation distances determine the area around each SDARS repeater in which FWS operation would be degraded, and therefore precluded. The exclusion zones are then correlated to a representative number of households that would be affected.

Our methodology and assumptions are further described below:

- Standard power is defined as 2 kW. High power is defined as 40 kW. In each case, power is distributed evenly over 5 MHz of spectrum.²⁸
- Degradation unacceptable to a lifeline service such as Project Angel occurs at a 1dB rise in the noise floor of a WCS receiver.
- The base station and RU provide approximately 62 dB of rejection to an adjacent band frequency.

Standard Power SDARS Repeater to FWS Base

Transmitter Power – Radiated Sensitivity = Required Path Loss to Avoid Interference

$$63 - (-45.1) = 108.1$$

Required SDARS to base path loss is 108.1 dB

Rewriting the free space path loss equation to solve for distance:

$$\text{SDARS to Base Distance} = 10^{((\text{SDARS to Base Path Loss} - 32.44 - 20\log(f))/20)}$$

$$\text{SDARS to Base Distance} = 10^{((108.1 - 32.44 - 20\log(2340))/20)}$$

SDARS to Base Distance = 2,600 meters.

High Power SDARS Repeater to FWS Base

Transmitter Power – Radiated Sensitivity = Required Path Loss to Avoid Interference

$$76 - (-45.1) = 121.1$$

Required SDARS to Base Path Loss = 121.1 dB

Rewriting the free space path loss equation to solve for distance:

$$\text{SDARS to Base Distance} = 10^{((\text{SDARS to Base Path Loss} - 32.44 - 10\log(f))/20)}$$

$$\text{SDARS to Base Distance} = 10^{((121.1 - 32.44 - 20\log(2340))/20)}$$

SDARS to Base Distance = 11,500 meters.

²⁸

Although Sirius apparently intends to operate its terrestrial repeaters in 4 MHz of spectrum, this analysis assumes that the power of the SDARS terrestrial is distributed evenly over 5 MHz of spectrum, as XM Radio apparently intends to do. The analysis would show a somewhat greater impact on AT&T's WCS service in a 4 MHz case.

Standard Power SDARS Repeater to RU

Transmitter Power – Radiated Sensitivity = Required Path Loss to Avoid Interference

$$63 - (-58.6) = 121.6$$

Required SDARS to RU Path Loss = 121.6 dB

The transmitter height is factored into the distance required to obtain the required path loss. The height is assumed to be 200 meters. The path loss distance is calculated using a tuned AT&T wireless propagation model (which is considerably more favorable to SDARS repeaters than standard free space models).

SDARS to RU Distance = 1,650 meters.

High Power SDARS Repeater to RU

Transmitter Power – Radiated Sensitivity = Required Path Loss to Avoid Interference

$$76 - (-58.6) = 134.6$$

Required SDARS to RU Path Loss = 134.6 dB

The transmitter height is factored into the distance required to obtain the required path loss. The height is assumed to be 200 meters. The path loss distance is calculated using a tuned AT&T wireless propagation model (which is considerably more favorable to SDARS repeaters than standard free space models).

SDARS to RU Distance = 4,850 meters

Household Counts

Our household count assumes an average of 525 households per square kilometer. In selecting this number, we considered two typical cities in which we intend to deploy fixed wireless service: Seattle, Washington and Houston, Texas. In Seattle, we measured the downtown core (800 HH/km²); the area just beyond (1100 HH/km²); and several areas at the perimeter of the city (450 HH/km²). Likewise, the household counts in Houston were measured in several different places: the downtown core, just outside the downtown core, and several miles to the north. In all these locations density was between 500 and 575 households per square kilometer, with an average of 525 households per square kilometer. For the purposes of this analysis, though Seattle shows a higher density and thus a greater exclusion effect, we use the Houston average of 525 households per square kilometer.

Households Affected (525 HH/km²)

Exclusion Radius, km	Exclusion Area, sq. km	Households Affected
1.650	8.553	4490
2.600	21.237	11150
4.850	73.898	38797
11.500	415.476	218125

According to the U.S. Census Bureau, there are 101,041,000 households in the United States. ST-98-46, Estimates of Housing Units, Households, Households by Age of Householder, and Persons per Household (July 1, 1998) (most recent data available).