Sprint
Together with NEXTEL

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February 7, 2006

BY ELECTRONIC FILING

Ms. Marlene H. Dortch, Secretary
Federal Communications Commission
The Portals
445 Twelfth Street, S.W.
Washington, D.C. 20554

Re: Adjacent and Co-Channel Interference in the 2510-2162 MHz Band
Oral and Written Ex Parte Presentation, ET Docket No. 00-258

Dear Ms. Dortch:

On February 7, 2006, representatives from Sprint Nextel Corporation (Sprint Nextel), Kessler and Gehman Associates, Inc. (KGA), and Axcera, LLC (Axcera) met with representatives from the Federal Communications Commission.[1] Sprint Nextel, KGA, and Axcera explained that licensees in the Broadband Radio Service (BRS) and licensees in the Advanced Wireless Services (AWS) cannot share the same or adjacent channels. The high-elevation centralized BRS receive station hub is designed to be extraordinarily sensitive to radiofrequency emissions because the transmissions that it must detect are weak and located at distances of up to 35 miles away.

Sprint Nextel reviewed the attached study and test data to demonstrate the degree to which BRS receive station hubs will experience harmful interference from operations in AWS Blocks A-F. The author of the technical analysis, Robert Gehman, has more than forty years of engineering experience and particular expertise in the design and evaluation of telecommunications systems in the 2.5 GHz band. The author of the test report, Axcera, is one of the nation's leading manufacturers of BRS and Educational Broadband Service (EBS) network equipment with a focus on network planning, design and integration services.

KGA concludes and the Axcera test data demonstrates that BRS and AWS cannot co-exist in the same geographic area. KGA shows that BRS 1-2 receive station hubs will experience harmful, system-disabling interference from AWS base stations even if AWS deployments were confined to the lowermost portion of the AWS Block A spectrum furthermost from BRS operations at 2150-2162 MHz. To prevent the disruption of BRS services to consumers from co-channel, adjacent-channel, and non-contiguous AWS base station emissions, therefore, KGA recommends that "[a]ll BRS operations in a given geographic area

[1] Harry Perlow, Michael Denny, and Trey Hanbury represented Sprint Nextel; Robert Gehman represented KGA; and R.W. Zborowski represented Axcera. Priya Shrinivasan, Patrick Forster, Jamison Prime, and Julius Knapp attended the meeting from the Commission's Office of Engineering Technology. Nancy Zaczek, Uzoma Onyeije, David Hu, and Peter Corea attended the meeting from the Commission's Wireless Telecommunications Bureau.

should be relocated before the Commission authorizes new AWS base stations to begin operating in that area."[2]

Sprint Nextel offers high-speed, wireless broadband service to fourteen geographic areas with a population of more than 33 million people. To avoid broadband service disruption to the American public, the Commission should require AWS new entrants that want to deploy within line of sight of a BRS receive station hub to first relocate that BRS system to its new location in the 2.5 GHz band. Please associate this submission with the above-referenced docket.

Sincerely,

Trey Hanbury, Esq.
Director, Sprint Nextel Corporation

CC: Geraldine Matisse, Jamison Prime, Priya Shrinivasan, Julius Knapp, Alan Scrime, David Hu, Patrick Forster, Nancy Zaczek, Uzoma Onyeije, Peter Corea, John Schaulble, Joel Taubenblatt, Catherine Seidel

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[2] Significantly, neither the KGA analysis nor the Axcera test data take into account the effect of the Commission's proposal to increase existing AWS power limits to 6560 watts EIRP and 13,120 watts EIRP in rural areas over more than three megahertz bandwidth.

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Jeffrey C. Gehman
Ryan C. Wilhour
William T. Godfrey

ENGINEERING STATEMENT
OF ROBERT GEHMAN, JR., P. E.

Kessler and Gehman Associates, Inc. ("KGA") is a professional engineering firm, specializing in the design and evaluation of telecommunications systems for more than 40 years. The firm has been involved in virtually every phase of TV and FM broadcast, microwave communications, fiber optic, cable TV and wireless cable (MDS/ITFS), satellite earth stations, and two-way radio communications systems. The services rendered by KGA have ranged from consulting services on a daily basis to studies of technical and economic feasibility and the design and construction follow-up of major telecommunications systems in widely diverse geographical areas. In particular the firm has had extensive experience in the design of systems in geographical areas where special attention has had to be devoted to effects of meteorological variations on system propagation reliability. Baseband information carried on communications systems designed by the firm includes video, data, telemetry, supervisory, wide bandwidth audio, and telephone either in combination or individually.

The qualifications of the firm's key technical personnel are a matter of record with the Federal Communications Commission. KGA has represented many clients before the FCC in a variety of matters, including rule making and waiver requests of the Commission's rules to accommodate specialized telecommunications systems. While the firm maintains a continuous dialogue with equipment suppliers, contractors and manufacturers of television, radio and telecommunications equipment, its relationship to such companies is limited solely to the contacts necessary for the planning and implementation of systems for the firm's clients. The firm engages only in providing consulting services to its clients, and is thus not involved in the promotion, manufacture, sale or installation of any equipment.

Introduction

The Advanced Wireless Services ("AWS") occupies paired spectrum in the 1710-1755 and 2110-2155 MHz frequency bands and the Broadband Radio Service ("BRS") occupies spectrum in the 2150-2162 MHz band. A portion of Part 27 of the FCC Rules (47CFR) related to AWS states that "The power of each fixed or base station transmitting in the 2110–2155 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to a peak equivalent isotropically radiated power (EIRP) of 3280 watts. The power of each fixed or base station transmitting in the 2110–

2155 MHz band from any other location is limited to a peak EIRP of 1640 watts." To be conservative, all references to the EIRP of AWS stations in this statement are based on the lower EIRP limit of 1,640 watts; no calculations have been based on the higher limit of 3,280 watts. Note that the bandwidth is not stated in this EIRP specification. It is understood that typical CDMA systems use 1,640 watts per 1.25 MHz carrier and typical GSM systems use 1,640 watts per 200 kHz carrier, neither of which were considered in this statement as a further testament to a conservative approach used in the technical evaluations.

The BRS channels have traditionally been used for upstream transmissions from the end user to a single Response Station Hub receiving facility ("RSH"). A previous engineering statement by the undersigned[1] demonstrated a strong potential for interference between AWS and BRS, indicating large geographical separations would be required to avoid causing mutual interference based on line-of-sight conditions. This engineering statement will clarify the claims made in my earlier statement and provide additional information collected from laboratory measurements and a computer simulation of an AWS system.

AWS – BRS Interference Considerations

Co-Channel AWS Base Station Interference to BRS Response Station Hubs

It was shown in my earlier statement that an AWS base station operating on the upper half of the F-block, even with an exceptionally low transmit power of 100 milliwatts ("mW"), would need to be located 1,259 miles away from a centralized BRS response station hub to prevent harmful co-channel interference if line of sight could exist at those extreme distances. Clearly, co-channel operation cannot be tolerated.

Adjacent and Non-Contiguous AWS Base Station Interference to BRS Response Station Hubs

As discussed in my earlier statement cellularization of AWS would result in multiple densely packed Base Stations. BRS Base Stations typically consist of ten sectors, each 36 degrees wide. The number of AWS base stations that might be in a single sector is a variable, and depends on the market population density and capacity requirements. It was demonstrated that 13 to 14 AWS base stations using cells with a 3-mile radius (area 28.3 sq mi) would be needed to serve a 36-degree sector with a 35-mile radius (area 384.8 sq mi), or a total of (13.6 transmitters x 5 blocks) about 68 AWS base station transmitters on five AWS frequency blocks (Blocks A – E, assuming AWS would not operate on Block F, the upper half of which is co-channel to BRS-1). Using the same methodology in dense population deployments capacity would require that AWS base stations be deployed with 2-mile radius cells, which would represent about 153 AWS base station transmitters in just one BRS 36-degree sector[2]. It was shown that if AWS were to operate just one base station with five transmitters simultaneously, such a facility would have to be located 138.8 miles away from a centralized BRS response station hub to prevent harmful interference. This obviously means the AWS and BRS base station antennas may not be within line of sight.

[1] Engineering Statement of Robert Gehman, Jr., P.E., dated November 21, 2005.
[2] An example is provided under a later topic in this statement of an actual Sprint sector with 112 sites.

All calculations were made using the FCC specified out-of-band emission ("OOBE") attenuation of 43 + 10 log10(P). It important to note that this OOBE applies equally to all AWS frequency blocks, A through F. There is no additional benefit to operating on the A block compared to the E block; the out-of-band interference caused by all AWS frequency blocks is equally destructive to BRS.

AWS – BRS Interference Demonstration

The attached report[3] by Axcera, LLC, includes the results of laboratory tests conducted to demonstrate the extent of cross modulation and intermodulation interference that would be caused to BRS by an AWS station. The Axcera report includes a complete methodology and the test configuration is shown in Figure 1.

AWS – BRS Mileage Separations Required to Avoid Degrading the BRS S/N

Sprint's BRS system uses QPSK modulation for upstream transmissions from the CPE to the RSH. Their field service department reports that the BRS systems are setup using a S/N goal of at least 22 dB to allow for a reasonable fade margin. The theoretical signal-to-noise ratio ("S/N") required for reliable demodulation of a QPSK signal is about 13 dB[4], but Sprint's field service department reports that the system is actually unusable at a S/N of 15 dB, as described in the attached Axcera report. A service call is initiated when the S/N falls to 20 dB, after which the system becomes problematic.

Figure A1 is a graph showing the maximum AWS interference signal level that can be tolerated without degrading the BRS S/N below 15 dB and 19 dB, based on the use of from one to eight AWS 5 MHz carriers. The calculations involved in creating the values for Figure A1 are shown on Figures A3.1 and A3.2 for a BRS S/N of 15 dB and 19 dB, respectively. The actual values for Figure A1 are shown in the columns headed B/W Adj'd to reflect the bandwidth-signal adjustments made to correct for the slight differences in the test bandwidths compared to the AWS channel-plan bandwidths. The raw data used in the calculations were taken directly from Axcera Figures 2 and 3.

Figure A2 is a graph showing the minimum mileage separations that an AWS station would have to maintain from a BRS station to prevent degrading the BRS signal-to-noise ratio below 15 dB and 19 dB based on the AWS station having from one to eight 5 MHz carriers. As stated above, a S/N of 15 dB results in an inoperable system and a S/N of 19 dB would require an immediate service call to avoid customer complaints. Figure A2 also shows the minimum separation for protection of the 15 dB and 19 dB S/N thresholds based on an example using 55 AWS stations, each having from one to eight 5 MHz carriers. The calculations involved in creating the mileage separation values for Figure A2 are shown on Figures A4.1 and A4.2 for a BRS S/N of 15 dB and 19 dB, respectively. The best-case scenario would be for all AWS stations to operate with only one 5-MHz carrier (the lower half of AWS Block A), which would still require all 55 AWS stations to be located outside of the BRS 35-mile GSA to protect the 19 dB S/N.

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[3] *Effects of Adjacent and Non-Contiguous Channel Interference on existing MDS Upstream Data Transmission Service*, Version 2.0, 01/27/06.

[4] Shannon's Law states that the highest obtainable error-free data rate is a function of the channel bandwidth and signal-to-noise ratio. Restated another way, the S/N required for a data channel depends on the channel bandwidth and acceptable error-free data rate, which may be affected by the type of error correction, if any is used. In general, a S/N of 13.5 dB will result in a QPSK BER of about 10^{-6} without error correction.

The BRS systems were designed using best practices for the frequency band in which they were intended. One obvious consideration to alleviate the destructive cross modulation and intermodulation interference that AWS would cause to BRS might be for BRS to employ improved filters at the front end of the preamplifiers. The BRS receivers are certainly not “outliers” and large filters were definitely not required when the receivers were deployed. Unfortunately, improved filters will not be not practical because ten filters would be required for each RSH (one for each sector), each of which would be quite large and all of which would have to be mounted adjacent to the preamplifier located high on the RSH towers.

AWS – BRS Interference Simulation based on Laboratory Test Results

A study was run using the transmitting facilities of the Houston PCS/iDEN system to simulate an actual AWS system. The study used the sites located within Sector 1, which is the 36-degree sector of the Houston system that is oriented toward 0 degrees true. There are 112 sites within Sector 1, ranging in distance from 0.7 to 33.8 miles from the RSH site.

Figure A6 (A6.1 through A6.8) shows the calculations of the signal level received at the BRS response station hub antenna from each of the 112 sites in Sector 1[5]. Calculations from each simulated AWS site were based on the use of from one to eight 5 MHz carriers. The total aggregated power received from all 112 sites is shown at the bottom of Figures A6.4 and A6.8, and is summarized here for the convenience of the reader. Note that 8 carriers includes only the lower half of the F block, 3 carriers includes only the lower half of the B block, and 1 carrier consists of the lower half of the A block.

	Number of 5 MHz Carriers Studied for Each of the 112 Stations							
	8	7	6	5	4	3	2	1
AWS Frequency Blocks:	A - F	A - E	A - D	A - C	A - B	A - B	A	A
AWS Frequency Range (MHz):	2110-2150	2110-2145	2110-2140	2110-2135	2110-2130	2110-2125	2110-2120	2110-2115
Total Aggregated Received Signal Levels - dBm	-11.37	-11.95	-12.62	-13.42	-14.38	-15.63	-17.39	-20.41
Maximum Signal Level to Protect **15 dB S/N** for number of carriers indicated - dBm	-52.96	-36.45	-36.00	-28.61	-29.30	-31.80	-31.56	-34.57
Degradation of 15 dB S/N - dB	**41.58**	**24.47**	**23.37**	**15.19**	**14.92**	**16.16**	**14.16**	**14.16**
Maximum Signal Level to Protect **19 dB S/N** for number of carriers indicated - dBm	-56.96	-43.45	-39.00	-33.61	-34.30	-36.80	-35.56	-38.37
Degradation of 19 dB S/N - dB	**45.58**	**31.49**	**26.37**	**20.19**	**19.91**	**21.16**	**18.16**	**18.16**

Conclusions

The above calculations demonstrate that BRS and AWS cannot co-exist in the same geographic area. All BRS operations in a given geographic area should be relocated before the Commission authorizes new AWS base stations to begin operating in that area to protect BRS against interference from cochannel, adjacent-channel, and non-contiguous AWS base station emissions.

[5] Results of calculations of the elevation angle from each site to the hub antenna ranged from 0.004 to 0.244 degrees above the horizontal. Based on a 16-bay antenna with 0.5-degree electrical down-tilt, the lowest relative field would be 0.93. A relative field of 0.93 was used for all EIRP calculations as a best-case scenario.

Engineering Statement

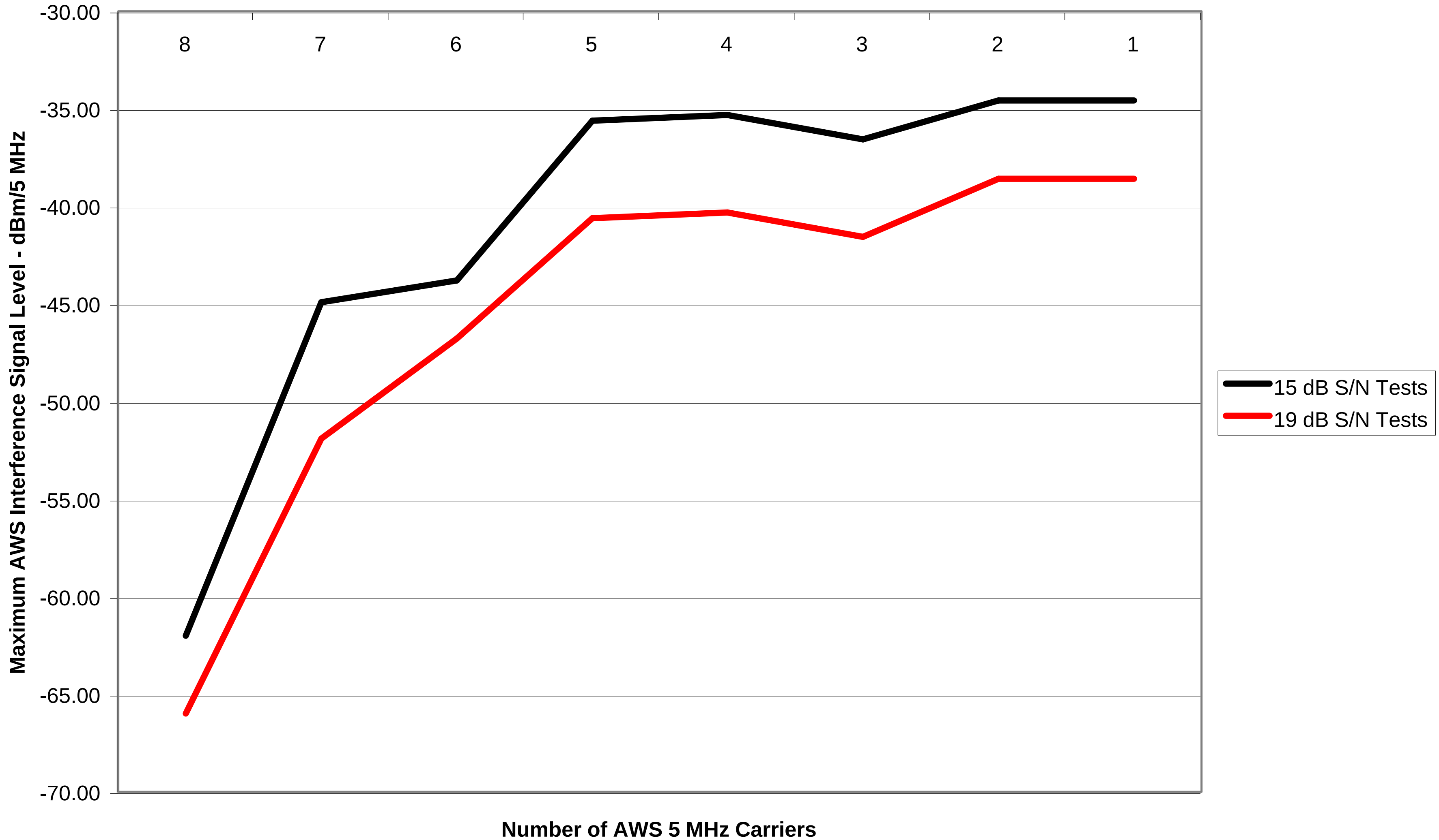
This engineering statement has been prepared by or under the direct supervision of Robert Gehman, Jr., who states under penalty of perjury that he is president of Kessler and Gehman Associates, Inc., telecommunications consulting engineers with offices in Gainesville, FL; a professional engineer licensed in several states with an established record at the National Council of Examiners for Engineering and Surveying ("NCEES"); a member of the Association of Federal Communications Consulting Engineers ("AFCCE"); a member of the Institute of Electrical and Electronic Engineers ("IEEE"); a member of the Society of Broadcast Engineers ("SBE"); and the information contained in this statement is true and correct to the best of his knowledge and belief.

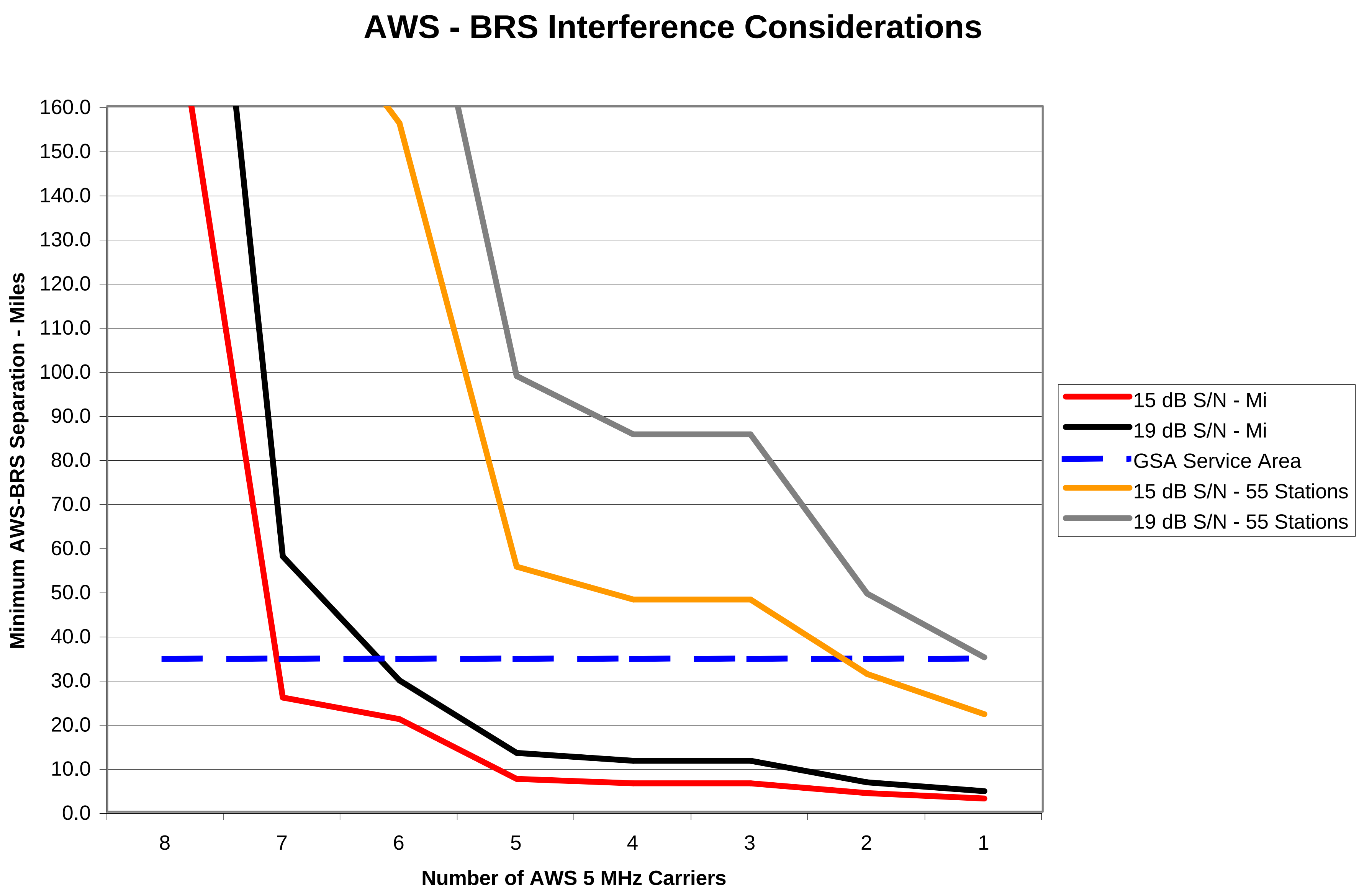
KESSLER AND GEHMAN ASSOCIATES, INC.

Robert Gehman, Jr., P. E.
President
(bob@kga.bz)

February 1, 2006

AWS - BRS Interference Considerations




AWS - BRS Interference Considerations
Minimum AWS-BRS Separation - Miles
160.0
150.0
140.0
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
8
7
6
5
4
3
2
1
Number of AWS 5 MHz Carriers
15 dB S/N - Mi
19 dB S/N - Mi
GSA Service Area
15 dB S/N - 55 Stations
19 dB S/N - 55 Stations

Reference Power of Each Test Carrier	-56.00	dBm/30 kHz
	-33.78	dBm/5 MHz
BRS Receiving Antenna Gain	16.00	dBi
Frequency	2150	MHz
Number of AWS Stations	1	

AWS							**Test**			***15 dB S/N Tests***				
EIRP - W	5 MHz Carriers	Equi-valent Blocks	Total B/W	EIRP - W	EIRP for 1 Stations	EIRP - dBm	6 MHz Carriers	Total B/W	B/W Adj	Atten- dB	dBm/ 5MHz Atten	B/W Adj'd	FS Loss	15 dB S/N - Mi
1,640	8	A - F/2	40	13,120	13,120	71.18	**7**	42	-0.21	**28.00**	-61.78	-61.99	-149.17	197.8
1,640	7	A - E	35	11,480	11,480	70.60	**6**	36	-0.12	**11.00**	-44.78	-44.90	-131.50	25.9
1,640	6	A - D	30	9,840	9,840	69.93	**5**	30	0.00	**10.00**	-43.78	-43.78	-129.71	21.0
1,640	5	A - C	25	8,200	8,200	69.14	**4**	24	0.18	**2.00**	-35.78	-35.60	-120.74	7.5
1,640	4	A - B	20	6,560	6,560	68.17	**3**	18	0.46	**2.00**	-35.78	-35.32	-119.49	6.5
1,640	3	A - B/2	15	4,920	4,920	66.92	**3**	18	-0.79	**2.00**	-35.78	-36.57	-119.49	6.5
1,640	2	A	10	3,280	3,280	65.16	**2**	12	-0.79	**0.00**	-33.78	-34.57	-115.73	4.2
1,640	1	A/2	5	1,640	1,640	62.15	**1**	6	-0.79	**0.00**	-33.78	-34.57	-112.72	3.0

Reference Power of Each Test Carrier	-56.00	dBm/30 kHz
	-33.78	dBm/5 MHz
BRS Receiving Antenna Gain	16.00	dBi
Frequency	2150	MHz
Number of AWS Stations	1	

AWS							**Test**			***19 dB S/N Tests***				
EIRP - W	5 MHz Carriers	Equi-valent Blocks	Total B/W	EIRP - W	EIRP for 1 Stations	EIRP - dBm	6 MHz Carriers	Total B/W	B/W Adj	Atten- dB	dBm/ 5MHz Atten	B/W Adj'd	FS Loss	19 dB S/N - Mi
1,640	8	A - F/2	40	13,120	13,120	71.18	**7**	42	-0.21	**32.00**	-65.78	-65.99	-153.17	313.5
1,640	7	A - E	35	11,480	11,480	70.60	**6**	36	-0.12	**18.00**	-51.78	-51.90	-138.50	57.9
1,640	6	A - D	30	9,840	9,840	69.93	**5**	30	0.00	**13.00**	-46.78	-46.78	-132.71	29.7
1,640	5	A - C	25	8,200	8,200	69.14	**4**	24	0.18	**7.00**	-40.78	-40.60	-125.74	13.3
1,640	4	A - B	20	6,560	6,560	68.17	**3**	18	0.46	**7.00**	-40.78	-40.32	-124.49	11.5
1,640	3	A - B/2	15	4,920	4,920	66.92	**3**	18	-0.79	**7.00**	-40.78	-41.57	-124.49	11.5
1,640	2	A	10	3,280	3,280	65.16	**2**	12	-0.79	**4.00**	-37.78	-38.57	-119.73	6.7
1,640	1	A/2	5	1,640	1,640	62.15	**1**	6	-0.79	**4.00**	-37.78	-38.57	-116.72	4.7

Reference Power of Each Test Carrier	-56.00	dBm/30 kHz
	-33.78	dBm/5 MHz
BRS Receiving Antenna Gain	16.00	dBi
Frequency	2150	MHz
Number of AWS Stations	55	

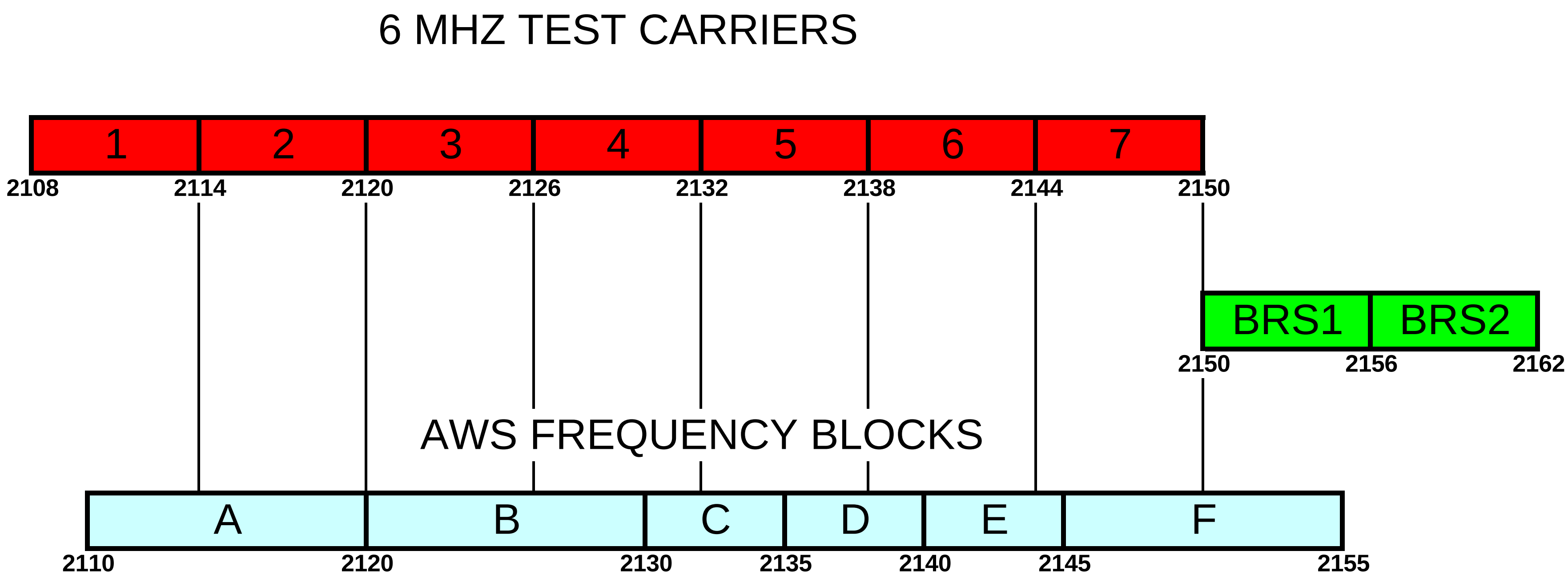
15 dB S/N - 55 Stations

AWS							**Test**			***15 dB S/N Tests***				
EIRP - W	5 MHz Carriers	Equi-valent Blocks	Total B/W	EIRP - W	EIRP for 55 Stations	EIRP - dBm	6 MHz Carriers	Total B/W	B/W Adj	Atten- dB	dBm/ 5MHz Atten	B/W Adj'd	FS Loss	15 dB S/N - Mi
1,640	8	A - F/2	40	13,120	721,600	88.58	**7**	42	-0.21	**28.00**	-61.78	-61.99	-166.58	1466.8
1,640	7	A - E	35	11,480	631,400	88.00	**6**	36	-0.12	**11.00**	-44.78	-44.90	-148.91	191.8
1,640	6	A - D	30	9,840	541,200	87.33	**5**	30	0.00	**10.00**	-43.78	-43.78	-147.12	156.1
1,640	5	A - C	25	8,200	451,000	86.54	**4**	24	0.18	**2.00**	-35.78	-35.60	-138.15	55.6
1,640	4	A - B	20	6,560	360,800	85.57	**3**	18	0.46	**2.00**	-35.78	-35.32	-136.90	48.1
1,640	3	A - B/2	15	4,920	270,600	84.32	**3**	18	-0.79	**2.00**	-35.78	-36.57	-136.90	48.1
1,640	2	A	10	3,280	180,400	82.56	**2**	12	-0.79	**0.00**	-33.78	-34.57	-133.14	31.2
1,640	1	A/2	5	1,640	90,200	79.55	**1**	6	-0.79	**0.00**	-33.78	-34.57	-130.13	22.1

Reference Power of Each Test Carrier	-56.00	dBm/30 kHz
	-33.78	dBm/5 MHz
BRS Receiving Antenna Gain	16.00	dBi
Frequency	2150	MHz
Number of AWS Stations	55	

19 dB S/N - 55 Stations

AWS							**Test**			***19 dB S/N Tests***				
EIRP - W	5 MHz Carriers	Equi-valent Blocks	Total B/W	EIRP - W	EIRP for 55 Stations	EIRP - dBm	6 MHz Carriers	Total B/W	B/W Adj	Atten- dB	dBm/ 5MHz Atten	B/W Adj'd	FS Loss	19 dB S/N - Mi
1,640	8	A - F/2	40	13,120	721,600	88.58	**7**	42	-0.21	**32.00**	-65.78	-65.99	-170.58	2324.8
1,640	7	A - E	35	11,480	631,400	88.00	**6**	36	-0.12	**18.00**	-51.78	-51.90	-155.91	429.4
1,640	6	A - D	30	9,840	541,200	87.33	**5**	30	0.00	**13.00**	-46.78	-46.78	-150.12	220.5
1,640	5	A - C	25	8,200	451,000	86.54	**4**	24	0.18	**7.00**	-40.78	-40.60	-143.15	98.8
1,640	4	A - B	20	6,560	360,800	85.57	**3**	18	0.46	**7.00**	-40.78	-40.32	-141.90	85.6
1,640	3	A - B/2	15	4,920	270,600	84.32	**3**	18	-0.79	**7.00**	-40.78	-41.57	-141.90	85.6
1,640	2	A	10	3,280	180,400	82.56	**2**	12	-0.79	**4.00**	-37.78	-38.57	-137.14	49.5
1,640	1	A/2	5	1,640	90,200	79.55	**1**	6	-0.79	**4.00**	-37.78	-38.57	-134.13	35.0


6 MHZ TEST CARRIERS
1
2
3
4
5
6
7
2108
2114
2120
2126
2132
2138
2144
2150
BRS1
BRS2
2150
2156
2162
AWS FREQUENCY BLOCKS
A
B
C
D
E
F
2110
2120
2130
2135
2140
2145
2155

BRS Receiving Antenna Gain	16	dBi
BRS Receiving Antenna height	984	Feet
Frequency	2150	MHz
Maximum EIRP	1640	Watts

							8		7		6		5	
							5 MHz Carriers		5 MHz Carriers		5 MHz Carriers		5 MHz Carriers	
Site ID	Tx Ant Ht	Distance Miles	F.S. Loss	Elev Angle	Est Rel Field	EIRP at Elev.	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW
HO03XC001	87	4.67	116.63	0.036	0.93	1418.4	11347	0.001	9929.1	0.0009	8510.6	0.0007	7092.2	0.0006
HO03XC002	67	5.01	117.25	0.035	0.93	1418.4	11347	0.0009	9929.1	0.0007	8510.6	0.0006	7092.2	0.0005
HO03XC004	103	6.53	119.55	0.026	0.93	1418.4	11347	0.0005	9929.1	0.0004	8510.6	0.0004	7092.2	0.0003
HO03XC005	74	7.58	120.84	0.023	0.93	1418.4	11347	0.0004	9929.1	0.0003	8510.6	0.0003	7092.2	0.0002
HO03XC006	88	8.58	121.92	0.020	0.93	1418.4	11347	0.0003	9929.1	0.0003	8510.6	0.0002	7092.2	0.0002
HO03XC007	90	9.52	122.82	0.018	0.93	1418.4	11347	0.0002	9929.1	0.0002	8510.6	0.0002	7092.2	0.0001
HO03XC008	98	11.60	124.53	0.014	0.93	1418.4	11347	0.0002	9929.1	0.0001	8510.6	0.0001	7092.2	1E-04
HO03XC009	87	9.76	123.04	0.017	0.93	1418.4	11347	0.0002	9929.1	0.0002	8510.6	0.0002	7092.2	0.0001
HO03XC010	89	7.78	121.07	0.022	0.93	1418.4	11347	0.0004	9929.1	0.0003	8510.6	0.0003	7092.2	0.0002
HO03XC011	75	5.64	118.27	0.031	0.93	1418.4	11347	0.0007	9929.1	0.0006	8510.6	0.0005	7092.2	0.0004
HO03XC017	120	11.36	124.36	0.014	0.93	1418.4	11347	0.0002	9929.1	0.0001	8510.6	0.0001	7092.2	0.0001
HO03XC022	74	3.08	113.01	0.056	0.93	1418.4	11347	0.0023	9929.1	0.002	8510.6	0.0017	7092.2	0.0014
HO03XC028	120	15.06	126.81	0.011	0.93	1418.4	11347	9E-05	9929.1	8E-05	8510.6	7E-05	7092.2	6E-05
HO03XC029	149	17.72	128.22	0.009	0.93	1418.4	11347	7E-05	9929.1	6E-05	8510.6	5E-05	7092.2	4E-05
HO03XC030	148	17.71	128.22	0.009	0.93	1418.4	11347	7E-05	9929.1	6E-05	8510.6	5E-05	7092.2	4E-05
HO03XC031	130	13.00	125.53	0.012	0.93	1418.4	11347	0.0001	9929.1	0.0001	8510.6	9E-05	7092.2	8E-05
HO03XC107	60	0.70	100.2	0.244	0.93	1418.4	11347	0.0432	9929.1	0.0378	8510.6	0.0324	7092.2	0.027
HO03XC116	65	15.98	127.32	0.011	0.93	1418.4	11347	8E-05	9929.1	7E-05	8510.6	6E-05	7092.2	5E-05
HO03XC117	64	15.79	127.22	0.011	0.93	1418.4	11347	9E-05	9929.1	8E-05	8510.6	6E-05	7092.2	5E-05
HO03XC122	120	26.54	131.73	0.006	0.93	1418.4	11347	3E-05	9929.1	3E-05	8510.6	2E-05	7092.2	2E-05
HO03XC301	103	6.15	119.02	0.027	0.93	1418.4	11347	0.0006	9929.1	0.0005	8510.6	0.0004	7092.2	0.0004
HO03XC307	145	11.51	124.47	0.014	0.93	1418.4	11347	0.0002	9929.1	0.0001	8510.6	0.0001	7092.2	0.0001
HO03XC324	78	6.18	119.07	0.028	0.93	1418.4	11347	0.0006	9929.1	0.0005	8510.6	0.0004	7092.2	0.0003
HO03XC331	150	13.75	126.02	0.011	0.93	1418.4	11347	0.0001	9929.1	1E-04	8510.6	8E-05	7092.2	7E-05
HO03XC334	106	17.81	128.26	0.009	0.93	1418.4	11347	7E-05	9929.1	6E-05	8510.6	5E-05	7092.2	4E-05
HO03XC400	138	18.34	128.51	0.009	0.93	1418.4	11347	6E-05	9929.1	6E-05	8510.6	5E-05	7092.2	4E-05
HO03XC401	108	19.92	129.24	0.008	0.93	1418.4	11347	5E-05	9929.1	5E-05	8510.6	4E-05	7092.2	3E-05
HO03XC402	180	27.52	132.04	0.006	0.93	1418.4	11347	3E-05	9929.1	2E-05	8510.6	2E-05	7092.2	2E-05
HO03XC403	190	25.40	131.35	0.006	0.93	1418.4	11347	3E-05	9929.1	3E-05	8510.6	2E-05	7092.2	2E-05
HO03XC404	180	31.35	133.17	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	1E-05
HO03XC405	166	31.54	133.23	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	1E-05

BRS Receiving Antenna Gain	16	dBi
BRS Receiving Antenna height	984	Feet
Frequency	2150	MHz
Maximum EIRP	1640	Watts

							8		7		6		5	
							5 MHz Carriers		5 MHz Carriers		5 MHz Carriers		5 MHz Carriers	
Site ID	Tx Ant Ht	Distance Miles	F.S. Loss	Elev Angle	Est Rel Field	EIRP at Elev.	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW
HO03XC416	190	31.69	133.27	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	1E-05
HO03XC425	184	24.81	131.14	0.006	0.93	1418.4	11347	3E-05	9929.1	3E-05	8510.6	3E-05	7092.2	2E-05
HO03XC426	180	33.80	133.83	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	1E-05	7092.2	1E-05
HO03XC427	177	28.75	132.42	0.005	0.93	1418.4	11347	3E-05	9929.1	2E-05	8510.6	2E-05	7092.2	2E-05
HO03XC428	138	28.03	132.2	0.006	0.93	1418.4	11347	3E-05	9929.1	2E-05	8510.6	2E-05	7092.2	2E-05
HO03XC429	188	31.89	133.32	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	1E-05
HO03XC447	152	23.72	130.75	0.007	0.93	1418.4	11347	4E-05	9929.1	3E-05	8510.6	3E-05	7092.2	2E-05
HO03XC643	123	12.28	125.03	0.013	0.93	1418.4	11347	0.0001	9929.1	0.0001	8510.6	0.0001	7092.2	9E-05
HO03XC645	157	29.41	132.62	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	2E-05
HO03XC714	149	21.63	129.95	0.007	0.93	1418.4	11347	5E-05	9929.1	4E-05	8510.6	3E-05	7092.2	3E-05
HO03XC715	173	26.83	131.82	0.006	0.93	1418.4	11347	3E-05	9929.1	3E-05	8510.6	2E-05	7092.2	2E-05
HO03XC716	190	26.70	131.78	0.006	0.93	1418.4	11347	3E-05	9929.1	3E-05	8510.6	2E-05	7092.2	2E-05
HO03XC740	159	29.37	132.61	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	2E-05
HO03XC761	151	23.13	130.53	0.007	0.93	1418.4	11347	4E-05	9929.1	3E-05	8510.6	3E-05	7092.2	2E-05
HO03XC762	138	31.05	133.09	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	1E-05
HO03XC769	190	33.71	133.8	0.004	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	1E-05	7092.2	1E-05
HO03XC818	108	13.32	125.74	0.012	0.93	1418.4	11347	0.0001	9929.1	0.0001	8510.6	9E-05	7092.2	8E-05
HO23XC035	120	12.86	125.44	0.013	0.93	1418.4	11347	0.0001	9929.1	0.0001	8510.6	1E-04	7092.2	8E-05
HO23XC271	110	15.94	127.3	0.010	0.93	1418.4	11347	8E-05	9929.1	7E-05	8510.6	6E-05	7092.2	5E-05
HO23XC273	100	15.87	127.26	0.011	0.93	1418.4	11347	8E-05	9929.1	7E-05	8510.6	6E-05	7092.2	5E-05
HO23XC274	150	20.33	129.41	0.008	0.93	1418.4	11347	5E-05	9929.1	5E-05	8510.6	4E-05	7092.2	3E-05
HO23XC275	168	27.89	132.16	0.006	0.93	1418.4	11347	3E-05	9929.1	2E-05	8510.6	2E-05	7092.2	2E-05
HO23XC547	105	4.28	115.87	0.039	0.93	1418.4	11347	0.0012	9929.1	0.001	8510.6	0.0009	7092.2	0.0007
HO23XC577	160	27.80	132.13	0.006	0.93	1418.4	11347	3E-05	9929.1	2E-05	8510.6	2E-05	7092.2	2E-05
HO23XC586	93	6.83	119.94	0.025	0.93	1418.4	11347	0.0005	9929.1	0.0004	8510.6	0.0003	7092.2	0.0003
HO23XC595	100	2.50	111.21	0.067	0.93	1418.4	11347	0.0034	9929.1	0.003	8510.6	0.0026	7092.2	0.0021
HO33XC479	160	26.02	131.55	0.006	0.93	1418.4	11347	3E-05	9929.1	3E-05	8510.6	2E-05	7092.2	2E-05
HO33XC480	120	20.46	129.47	0.008	0.93	1418.4	11347	5E-05	9929.1	4E-05	8510.6	4E-05	7092.2	3E-05
HO54XC675	180	32.10	133.38	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	1E-05
HO54XC676	120	30.59	132.96	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	1E-05
HO54XC677	140	29.53	132.65	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	2E-05

BRS Receiving Antenna Gain	16	dBi
BRS Receiving Antenna height	984	Feet
Frequency	2150	MHz
Maximum EIRP	1640	Watts

							8		7		6		5	
							5 MHz Carriers		5 MHz Carriers		5 MHz Carriers		5 MHz Carriers	
Site ID	Tx Ant Ht	Distance Miles	F.S. Loss	Elev Angle	Est Rel Field	EIRP at Elev.	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW
HO54XC678	140	30.41	132.91	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	1E-05
HO54XC679	194	28.31	132.29	0.005	0.93	1418.4	11347	3E-05	9929.1	2E-05	8510.6	2E-05	7092.2	2E-05
HO54XC680	140	24.27	130.95	0.007	0.93	1418.4	11347	4E-05	9929.1	3E-05	8510.6	3E-05	7092.2	2E-05
HO57XC861	120	17.62	128.17	0.009	0.93	1418.4	11347	7E-05	9929.1	6E-05	8510.6	5E-05	7092.2	4E-05
HO58XC183	150	20.61	129.53	0.008	0.93	1418.4	11347	5E-05	9929.1	4E-05	8510.6	4E-05	7092.2	3E-05
HO58XC195	180	31.43	133.2	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	1E-05
HO58XC353	120	20.04	129.28	0.008	0.93	1418.4	11347	5E-05	9929.1	5E-05	8510.6	4E-05	7092.2	3E-05
HO60XC173	100	17.61	128.17	0.010	0.93	1418.4	11347	7E-05	9929.1	6E-05	8510.6	5E-05	7092.2	4E-05
HO60XC970	140	19.39	129	0.008	0.93	1418.4	11347	6E-05	9929.1	5E-05	8510.6	4E-05	7092.2	4E-05
NTX1001R_I	60	15.94	127.3	0.011	0.93	1418.4	11347	8E-05	9929.1	7E-05	8510.6	6E-05	7092.2	5E-05
NTX1024R_I	190	30.99	133.07	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	1E-05
NTX1028R_I	150	20.05	129.29	0.008	0.93	1418.4	11347	5E-05	9929.1	5E-05	8510.6	4E-05	7092.2	3E-05
NTX1029R_I	184	29.73	132.71	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	2E-05
NTX1030R_I	180	26.88	131.84	0.006	0.93	1418.4	11347	3E-05	9929.1	3E-05	8510.6	2E-05	7092.2	2E-05
NTX1036R_I	180	31.70	133.27	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	1E-05
NTX1067R_I	95	4.63	116.56	0.036	0.93	1418.4	11347	0.001	9929.1	0.0009	8510.6	0.0007	7092.2	0.0006
NTX1070R_I	115	7.61	120.88	0.022	0.93	1418.4	11347	0.0004	9929.1	0.0003	8510.6	0.0003	7092.2	0.0002
NTX1078R_I	100	13.11	125.6	0.013	0.93	1418.4	11347	0.0001	9929.1	0.0001	8510.6	9E-05	7092.2	8E-05
NTX1096R_I	150	29.36	132.6	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	2E-05
NTX1202R_I	175	33.70	133.8	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	1E-05	7092.2	1E-05
NTX1309R_I	156	4.07	115.43	0.039	0.93	1418.4	11347	0.0013	9929.1	0.0011	8510.6	0.001	7092.2	0.0008
NTX1319R_I	118	10.74	123.87	0.015	0.93	1418.4	11347	0.0002	9929.1	0.0002	8510.6	0.0001	7092.2	0.0001
NTX1327R_I	157	20.32	129.41	0.008	0.93	1418.4	11347	5E-05	9929.1	5E-05	8510.6	4E-05	7092.2	3E-05
NTX1328R_I	121	15.08	126.81	0.011	0.93	1418.4	11347	9E-05	9929.1	8E-05	8510.6	7E-05	7092.2	6E-05
NTX1329R_I	118	16.97	127.84	0.010	0.93	1418.4	11347	7E-05	9929.1	6E-05	8510.6	6E-05	7092.2	5E-05
NTX1337R_I	183	12.86	125.43	0.012	0.93	1418.4	11347	0.0001	9929.1	0.0001	8510.6	1E-04	7092.2	8E-05
NTX1339R_I	190	22.69	130.36	0.007	0.93	1418.4	11347	4E-05	9929.1	4E-05	8510.6	3E-05	7092.2	3E-05
NTX1340R_I	190	30.03	132.8	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	1E-05
NTX1397R_I	80	3.29	113.59	0.052	0.93	1418.4	11347	0.002	9929.1	0.0017	8510.6	0.0015	7092.2	0.0012
NTX1398R_I	120	10.95	124.03	0.015	0.93	1418.4	11347	0.0002	9929.1	0.0002	8510.6	0.0001	7092.2	0.0001
NTX1399R_I	110	10.87	123.97	0.015	0.93	1418.4	11347	0.0002	9929.1	0.0002	8510.6	0.0001	7092.2	0.0001

BRS Receiving Antenna Gain	16	dBi
BRS Receiving Antenna height	984	Feet
Frequency	2150	MHz
Maximum EIRP	1640	Watts

							8		**7**		**6**		**5**	
							5 MHz Carriers		5 MHz Carriers		5 MHz Carriers		5 MHz Carriers	
Site ID	Tx Ant Ht	Distance Miles	F.S. Loss	Elev Angle	Est Rel Field	EIRP at Elev.	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW
NTX1431R_I	160	33.78	133.82	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	1E-05	7092.2	1E-05
NTX1443R_I	120	18.15	128.43	0.009	0.93	1418.4	11347	6E-05	9929.1	6E-05	8510.6	5E-05	7092.2	4E-05
NTX1444R_I	110	15.36	126.98	0.011	0.93	1418.4	11347	9E-05	9929.1	8E-05	8510.6	7E-05	7092.2	6E-05
NTX1459R_I	100	14.71	126.6	0.011	0.93	1418.4	11347	1E-04	9929.1	9E-05	8510.6	7E-05	7092.2	6E-05
NTX1461R_I	120	9.06	122.39	0.018	0.93	1418.4	11347	0.0003	9929.1	0.0002	8510.6	0.0002	7092.2	0.0002
NTX1462R_I	85	6.41	119.38	0.027	0.93	1418.4	11347	0.0005	9929.1	0.0005	8510.6	0.0004	7092.2	0.0003
NTX1493R_I	152	8.55	121.89	0.018	0.93	1418.4	11347	0.0003	9929.1	0.0003	8510.6	0.0002	7092.2	0.0002
NTX1495R_I	200	26.84	131.82	0.006	0.93	1418.4	11347	3E-05	9929.1	3E-05	8510.6	2E-05	7092.2	2E-05
NTX1496R_I	173	31.07	133.1	0.005	0.93	1418.4	11347	2E-05	9929.1	2E-05	8510.6	2E-05	7092.2	1E-05
NTX1497R_I	117	5.52	118.09	0.030	0.93	1418.4	11347	0.0007	9929.1	0.0006	8510.6	0.0005	7092.2	0.0004
NTX1498R_I	160	13.74	126.01	0.011	0.93	1418.4	11347	0.0001	9929.1	1E-04	8510.6	8E-05	7092.2	7E-05
NTX1510R_I	118	17.89	128.3	0.009	0.93	1418.4	11347	7E-05	9929.1	6E-05	8510.6	5E-05	7092.2	4E-05
NTX1616R_I	120	26.23	131.63	0.006	0.93	1418.4	11347	3E-05	9929.1	3E-05	8510.6	2E-05	7092.2	2E-05
NTX1635R_I	130	28.64	132.39	0.006	0.93	1418.4	11347	3E-05	9929.1	2E-05	8510.6	2E-05	7092.2	2E-05
NTX1702R_I	100	21.20	129.78	0.008	0.93	1418.4	11347	5E-05	9929.1	4E-05	8510.6	4E-05	7092.2	3E-05
NTX1704R_I	145	17.38	128.05	0.009	0.93	1418.4	11347	7E-05	9929.1	6E-05	8510.6	5E-05	7092.2	4E-05
NTX1705R_I	100	13.14	125.62	0.013	0.93	1418.4	11347	0.0001	9929.1	0.0001	8510.6	9E-05	7092.2	8E-05
NTX1707R_I	62	2.11	109.72	0.083	0.93	1418.4	11347	0.0048	9929.1	0.0042	8510.6	0.0036	7092.2	0.003
NTX1812R_I	140	8.60	121.94	0.019	0.93	1418.4	11347	0.0003	9929.1	0.0003	8510.6	0.0002	7092.2	0.0002
Total Aggregated Received Signal Levels - milliwatts								0.0729		0.0638		0.0547		0.0455
Total Aggregated Received Signal Levels - dBm								**-11.37**		**-11.95**		**-12.62**		**-13.42**
Maximum Signal Level to Protect **15 dB S/N** - dBm/5 MHz								-61.99		-44.90		-43.78		-35.60
Adjusted for Number of 5 MHz Carriers - dBm								-52.96		-36.45		-36.00		-28.61
Degradation of 15 dB S/N - dB								**41.58**		**24.49**		**23.37**		**15.19**
Maximum Signal Level to Protect **19 dB S/N** - dBm/5 MHz								-65.99		-51.90		-46.78		-40.60
Adjusted for Number of 5 MHz Carriers - dBm								-56.96		-43.45		-39.00		-33.61
Degradation of 19 dB S/N - dB								**45.58**		**31.49**		**26.37**		**20.19**

BRS Receiving Antenna Gain	16	dBi
BRS Receiving Antenna height	984	Feet
Frequency	2150	MHz
Maximum EIRP	1640	Watts

							4		3		2		1	
							5 MHz Carriers		5 MHz Carriers		5 MHz Carriers		5 MHz Carrier	
Site ID	Tx Ant Ht	Distance Miles	F.S. Loss	Elev Angle	Est Rel Field	EIRP at Elev.	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW
HO03XC001	87	4.67	116.63	0.036	0.93	1418.4	5673.7	0.0005	4255.3	0.0004	2836.9	0.0002	1418.4	0.0001
HO03XC002	67	5.01	117.25	0.035	0.93	1418.4	5673.7	0.0004	4255.3	0.0003	2836.9	0.0002	1418.4	0.0001
HO03XC004	103	6.53	119.55	0.026	0.93	1418.4	5673.7	0.0003	4255.3	0.0002	2836.9	0.0001	1418.4	6E-05
HO03XC005	74	7.58	120.84	0.023	0.93	1418.4	5673.7	0.0002	4255.3	0.0001	2836.9	9E-05	1418.4	5E-05
HO03XC006	88	8.58	121.92	0.020	0.93	1418.4	5673.7	0.0001	4255.3	0.0001	2836.9	7E-05	1418.4	4E-05
HO03XC007	90	9.52	122.82	0.018	0.93	1418.4	5673.7	0.0001	4255.3	9E-05	2836.9	6E-05	1418.4	3E-05
HO03XC008	98	11.60	124.53	0.014	0.93	1418.4	5673.7	8E-05	4255.3	6E-05	2836.9	4E-05	1418.4	2E-05
HO03XC009	87	9.76	123.04	0.017	0.93	1418.4	5673.7	0.0001	4255.3	8E-05	2836.9	6E-05	1418.4	3E-05
HO03XC010	89	7.78	121.07	0.022	0.93	1418.4	5673.7	0.0002	4255.3	0.0001	2836.9	9E-05	1418.4	4E-05
HO03XC011	75	5.64	118.27	0.031	0.93	1418.4	5673.7	0.0003	4255.3	0.0003	2836.9	0.0002	1418.4	8E-05
HO03XC017	120	11.36	124.36	0.014	0.93	1418.4	5673.7	8E-05	4255.3	6E-05	2836.9	4E-05	1418.4	2E-05
HO03XC022	74	3.08	113.01	0.056	0.93	1418.4	5673.7	0.0011	4255.3	0.0008	2836.9	0.0006	1418.4	0.0003
HO03XC028	120	15.06	126.81	0.011	0.93	1418.4	5673.7	5E-05	4255.3	4E-05	2836.9	2E-05	1418.4	1E-05
HO03XC029	149	17.72	128.22	0.009	0.93	1418.4	5673.7	3E-05	4255.3	3E-05	2836.9	2E-05	1418.4	9E-06
HO03XC030	148	17.71	128.22	0.009	0.93	1418.4	5673.7	3E-05	4255.3	3E-05	2836.9	2E-05	1418.4	9E-06
HO03XC031	130	13.00	125.53	0.012	0.93	1418.4	5673.7	6E-05	4255.3	5E-05	2836.9	3E-05	1418.4	2E-05
HO03XC107	60	0.70	100.2	0.244	0.93	1418.4	5673.7	0.0216	4255.3	0.0162	2836.9	0.0108	1418.4	0.0054
HO03XC116	65	15.98	127.32	0.011	0.93	1418.4	5673.7	4E-05	4255.3	3E-05	2836.9	2E-05	1418.4	1E-05
HO03XC117	64	15.79	127.22	0.011	0.93	1418.4	5673.7	4E-05	4255.3	3E-05	2836.9	2E-05	1418.4	1E-05
HO03XC122	120	26.54	131.73	0.006	0.93	1418.4	5673.7	2E-05	4255.3	1E-05	2836.9	8E-06	1418.4	4E-06
HO03XC301	103	6.15	119.02	0.027	0.93	1418.4	5673.7	0.0003	4255.3	0.0002	2836.9	0.0001	1418.4	7E-05
HO03XC307	145	11.51	124.47	0.014	0.93	1418.4	5673.7	8E-05	4255.3	6E-05	2836.9	4E-05	1418.4	2E-05
HO03XC324	78	6.18	119.07	0.028	0.93	1418.4	5673.7	0.0003	4255.3	0.0002	2836.9	0.0001	1418.4	7E-05
HO03XC331	150	13.75	126.02	0.011	0.93	1418.4	5673.7	6E-05	4255.3	4E-05	2836.9	3E-05	1418.4	1E-05
HO03XC334	106	17.81	128.26	0.009	0.93	1418.4	5673.7	3E-05	4255.3	3E-05	2836.9	2E-05	1418.4	8E-06
HO03XC400	138	18.34	128.51	0.009	0.93	1418.4	5673.7	3E-05	4255.3	2E-05	2836.9	2E-05	1418.4	8E-06
HO03XC401	108	19.92	129.24	0.008	0.93	1418.4	5673.7	3E-05	4255.3	2E-05	2836.9	1E-05	1418.4	7E-06
HO03XC402	180	27.52	132.04	0.006	0.93	1418.4	5673.7	1E-05	4255.3	1E-05	2836.9	7E-06	1418.4	4E-06
HO03XC403	190	25.40	131.35	0.006	0.93	1418.4	5673.7	2E-05	4255.3	1E-05	2836.9	8E-06	1418.4	4E-06
HO03XC404	180	31.35	133.17	0.005	0.93	1418.4	5673.7	1E-05	4255.3	8E-06	2836.9	5E-06	1418.4	3E-06
HO03XC405	166	31.54	133.23	0.005	0.93	1418.4	5673.7	1E-05	4255.3	8E-06	2836.9	5E-06	1418.4	3E-06

BRS Receiving Antenna Gain	16	dBi
BRS Receiving Antenna height	984	Feet
Frequency	2150	MHz
Maximum EIRP	1640	Watts

							4		3		2		1	
							5 MHz Carriers		5 MHz Carriers		5 MHz Carriers		5 MHz Carrier	
Site ID	Tx Ant Ht	Distance Miles	F.S. Loss	Elev Angle	Est Rel Field	EIRP at Elev.	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW
HO03XC416	190	31.69	133.27	0.005	0.93	1418.4	5673.7	1E-05	4255.3	8E-06	2836.9	5E-06	1418.4	3E-06
HO03XC425	184	24.81	131.14	0.006	0.93	1418.4	5673.7	2E-05	4255.3	1E-05	2836.9	9E-06	1418.4	4E-06
HO03XC426	180	33.80	133.83	0.005	0.93	1418.4	5673.7	9E-06	4255.3	7E-06	2836.9	5E-06	1418.4	2E-06
HO03XC427	177	28.75	132.42	0.005	0.93	1418.4	5673.7	1E-05	4255.3	1E-05	2836.9	6E-06	1418.4	3E-06
HO03XC428	138	28.03	132.2	0.006	0.93	1418.4	5673.7	1E-05	4255.3	1E-05	2836.9	7E-06	1418.4	3E-06
HO03XC429	188	31.89	133.32	0.005	0.93	1418.4	5673.7	1E-05	4255.3	8E-06	2836.9	5E-06	1418.4	3E-06
HO03XC447	152	23.72	130.75	0.007	0.93	1418.4	5673.7	2E-05	4255.3	1E-05	2836.9	9E-06	1418.4	5E-06
HO03XC643	123	12.28	125.03	0.013	0.93	1418.4	5673.7	7E-05	4255.3	5E-05	2836.9	4E-05	1418.4	2E-05
HO03XC645	157	29.41	132.62	0.005	0.93	1418.4	5673.7	1E-05	4255.3	9E-06	2836.9	6E-06	1418.4	3E-06
HO03XC714	149	21.63	129.95	0.007	0.93	1418.4	5673.7	2E-05	4255.3	2E-05	2836.9	1E-05	1418.4	6E-06
HO03XC715	173	26.83	131.82	0.006	0.93	1418.4	5673.7	1E-05	4255.3	1E-05	2836.9	7E-06	1418.4	4E-06
HO03XC716	190	26.70	131.78	0.006	0.93	1418.4	5673.7	1E-05	4255.3	1E-05	2836.9	7E-06	1418.4	4E-06
HO03XC740	159	29.37	132.61	0.005	0.93	1418.4	5673.7	1E-05	4255.3	9E-06	2836.9	6E-06	1418.4	3E-06
HO03XC761	151	23.13	130.53	0.007	0.93	1418.4	5673.7	2E-05	4255.3	1E-05	2836.9	1E-05	1418.4	5E-06
HO03XC762	138	31.05	133.09	0.005	0.93	1418.4	5673.7	1E-05	4255.3	8E-06	2836.9	6E-06	1418.4	3E-06
HO03XC769	190	33.71	133.8	0.004	0.93	1418.4	5673.7	9E-06	4255.3	7E-06	2836.9	5E-06	1418.4	2E-06
HO03XC818	108	13.32	125.74	0.012	0.93	1418.4	5673.7	6E-05	4255.3	5E-05	2836.9	3E-05	1418.4	2E-05
HO23XC035	120	12.86	125.44	0.013	0.93	1418.4	5673.7	6E-05	4255.3	5E-05	2836.9	3E-05	1418.4	2E-05
HO23XC271	110	15.94	127.3	0.010	0.93	1418.4	5673.7	4E-05	4255.3	3E-05	2836.9	2E-05	1418.4	1E-05
HO23XC273	100	15.87	127.26	0.011	0.93	1418.4	5673.7	4E-05	4255.3	3E-05	2836.9	2E-05	1418.4	1E-05
HO23XC274	150	20.33	129.41	0.008	0.93	1418.4	5673.7	3E-05	4255.3	2E-05	2836.9	1E-05	1418.4	6E-06
HO23XC275	168	27.89	132.16	0.006	0.93	1418.4	5673.7	1E-05	4255.3	1E-05	2836.9	7E-06	1418.4	3E-06
HO23XC547	105	4.28	115.87	0.039	0.93	1418.4	5673.7	0.0006	4255.3	0.0004	2836.9	0.0003	1418.4	0.0001
HO23XC577	160	27.80	132.13	0.006	0.93	1418.4	5673.7	1E-05	4255.3	1E-05	2836.9	7E-06	1418.4	3E-06
HO23XC586	93	6.83	119.94	0.025	0.93	1418.4	5673.7	0.0002	4255.3	0.0002	2836.9	0.0001	1418.4	6E-05
HO23XC595	100	2.50	111.21	0.067	0.93	1418.4	5673.7	0.0017	4255.3	0.0013	2836.9	0.0009	1418.4	0.0004
HO33XC479	160	26.02	131.55	0.006	0.93	1418.4	5673.7	2E-05	4255.3	1E-05	2836.9	8E-06	1418.4	4E-06
HO33XC480	120	20.46	129.47	0.008	0.93	1418.4	5673.7	3E-05	4255.3	2E-05	2836.9	1E-05	1418.4	6E-06
HO54XC675	180	32.10	133.38	0.005	0.93	1418.4	5673.7	1E-05	4255.3	8E-06	2836.9	5E-06	1418.4	3E-06
HO54XC676	120	30.59	132.96	0.005	0.93	1418.4	5673.7	1E-05	4255.3	9E-06	2836.9	6E-06	1418.4	3E-06
HO54XC677	140	29.53	132.65	0.005	0.93	1418.4	5673.7	1E-05	4255.3	9E-06	2836.9	6E-06	1418.4	3E-06

BRS Receiving Antenna Gain	16	dBi
BRS Receiving Antenna height	984	Feet
Frequency	2150	MHz
Maximum EIRP	1640	Watts

							4		3		2		1	
							5 MHz Carriers		5 MHz Carriers		5 MHz Carriers		5 MHz Carrier	
Site ID	Tx Ant Ht	Distance Miles	F.S. Loss	Elev Angle	Est Rel Field	EIRP at Elev.	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW
HO54XC678	140	30.41	132.91	0.005	0.93	1418.4	5673.7	1E-05	4255.3	9E-06	2836.9	6E-06	1418.4	3E-06
HO54XC679	194	28.31	132.29	0.005	0.93	1418.4	5673.7	1E-05	4255.3	1E-05	2836.9	7E-06	1418.4	3E-06
HO54XC680	140	24.27	130.95	0.007	0.93	1418.4	5673.7	2E-05	4255.3	1E-05	2836.9	9E-06	1418.4	5E-06
HO57XC861	120	17.62	128.17	0.009	0.93	1418.4	5673.7	3E-05	4255.3	3E-05	2836.9	2E-05	1418.4	9E-06
HO58XC183	150	20.61	129.53	0.008	0.93	1418.4	5673.7	3E-05	4255.3	2E-05	2836.9	1E-05	1418.4	6E-06
HO58XC195	180	31.43	133.2	0.005	0.93	1418.4	5673.7	1E-05	4255.3	8E-06	2836.9	5E-06	1418.4	3E-06
HO58XC353	120	20.04	129.28	0.008	0.93	1418.4	5673.7	3E-05	4255.3	2E-05	2836.9	1E-05	1418.4	7E-06
HO60XC173	100	17.61	128.17	0.010	0.93	1418.4	5673.7	3E-05	4255.3	3E-05	2836.9	2E-05	1418.4	9E-06
HO60XC970	140	19.39	129	0.008	0.93	1418.4	5673.7	3E-05	4255.3	2E-05	2836.9	1E-05	1418.4	7E-06
NTX1001R_I	60	15.94	127.3	0.011	0.93	1418.4	5673.7	4E-05	4255.3	3E-05	2836.9	2E-05	1418.4	1E-05
NTX1024R_I	190	30.99	133.07	0.005	0.93	1418.4	5673.7	1E-05	4255.3	8E-06	2836.9	6E-06	1418.4	3E-06
NTX1028R_I	150	20.05	129.29	0.008	0.93	1418.4	5673.7	3E-05	4255.3	2E-05	2836.9	1E-05	1418.4	7E-06
NTX1029R_I	184	29.73	132.71	0.005	0.93	1418.4	5673.7	1E-05	4255.3	9E-06	2836.9	6E-06	1418.4	3E-06
NTX1030R_I	180	26.88	131.84	0.006	0.93	1418.4	5673.7	1E-05	4255.3	1E-05	2836.9	7E-06	1418.4	4E-06
NTX1036R_I	180	31.70	133.27	0.005	0.93	1418.4	5673.7	1E-05	4255.3	8E-06	2836.9	5E-06	1418.4	3E-06
NTX1067R_I	95	4.63	116.56	0.036	0.93	1418.4	5673.7	0.0005	4255.3	0.0004	2836.9	0.0002	1418.4	0.0001
NTX1070R_I	115	7.61	120.88	0.022	0.93	1418.4	5673.7	0.0002	4255.3	0.0001	2836.9	9E-05	1418.4	5E-05
NTX1078R_I	100	13.11	125.6	0.013	0.93	1418.4	5673.7	6E-05	4255.3	5E-05	2836.9	3E-05	1418.4	2E-05
NTX1096R_I	150	29.36	132.6	0.005	0.93	1418.4	5673.7	1E-05	4255.3	9E-06	2836.9	6E-06	1418.4	3E-06
NTX1202R_I	175	33.70	133.8	0.005	0.93	1418.4	5673.7	9E-06	4255.3	7E-06	2836.9	5E-06	1418.4	2E-06
NTX1309R_I	156	4.07	115.43	0.039	0.93	1418.4	5673.7	0.0006	4255.3	0.0005	2836.9	0.0003	1418.4	0.0002
NTX1319R_I	118	10.74	123.87	0.015	0.93	1418.4	5673.7	9E-05	4255.3	7E-05	2836.9	5E-05	1418.4	2E-05
NTX1327R_I	157	20.32	129.41	0.008	0.93	1418.4	5673.7	3E-05	4255.3	2E-05	2836.9	1E-05	1418.4	6E-06
NTX1328R_I	121	15.08	126.81	0.011	0.93	1418.4	5673.7	5E-05	4255.3	4E-05	2836.9	2E-05	1418.4	1E-05
NTX1329R_I	118	16.97	127.84	0.010	0.93	1418.4	5673.7	4E-05	4255.3	3E-05	2836.9	2E-05	1418.4	9E-06
NTX1337R_I	183	12.86	125.43	0.012	0.93	1418.4	5673.7	6E-05	4255.3	5E-05	2836.9	3E-05	1418.4	2E-05
NTX1339R_I	190	22.69	130.36	0.007	0.93	1418.4	5673.7	2E-05	4255.3	2E-05	2836.9	1E-05	1418.4	5E-06
NTX1340R_I	190	30.03	132.8	0.005	0.93	1418.4	5673.7	1E-05	4255.3	9E-06	2836.9	6E-06	1418.4	3E-06
NTX1397R_I	80	3.29	113.59	0.052	0.93	1418.4	5673.7	0.001	4255.3	0.0007	2836.9	0.0005	1418.4	0.0002
NTX1398R_I	120	10.95	124.03	0.015	0.93	1418.4	5673.7	9E-05	4255.3	7E-05	2836.9	4E-05	1418.4	2E-05
NTX1399R_I	110	10.87	123.97	0.015	0.93	1418.4	5673.7	9E-05	4255.3	7E-05	2836.9	5E-05	1418.4	2E-05

BRS Receiving Antenna Gain	16	dBi
BRS Receiving Antenna height	984	Feet
Frequency	2150	MHz
Maximum EIRP	1640	Watts

							4		**3**		**2**		**1**	
							5 MHz Carriers		5 MHz Carriers		5 MHz Carriers		5 MHz Carrier	
Site ID	Tx Ant Ht	Distance Miles	F.S. Loss	Elev Angle	Est Rel Field	EIRP at Elev.	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW	Total EIRP Watts	RSL mW
NTX1431R_I	160	33.78	133.82	0.005	0.93	1418.4	5673.7	9E-06	4255.3	7E-06	2836.9	5E-06	1418.4	2E-06
NTX1443R_I	120	18.15	128.43	0.009	0.93	1418.4	5673.7	3E-05	4255.3	2E-05	2836.9	2E-05	1418.4	8E-06
NTX1444R_I	110	15.36	126.98	0.011	0.93	1418.4	5673.7	5E-05	4255.3	3E-05	2836.9	2E-05	1418.4	1E-05
NTX1459R_I	100	14.71	126.6	0.011	0.93	1418.4	5673.7	5E-05	4255.3	4E-05	2836.9	2E-05	1418.4	1E-05
NTX1461R_I	120	9.06	122.39	0.018	0.93	1418.4	5673.7	0.0001	4255.3	1E-04	2836.9	7E-05	1418.4	3E-05
NTX1462R_I	85	6.41	119.38	0.027	0.93	1418.4	5673.7	0.0003	4255.3	0.0002	2836.9	0.0001	1418.4	7E-05
NTX1493R_I	152	8.55	121.89	0.018	0.93	1418.4	5673.7	0.0001	4255.3	0.0001	2836.9	7E-05	1418.4	4E-05
NTX1495R_I	200	26.84	131.82	0.006	0.93	1418.4	5673.7	1E-05	4255.3	1E-05	2836.9	7E-06	1418.4	4E-06
NTX1496R_I	173	31.07	133.1	0.005	0.93	1418.4	5673.7	1E-05	4255.3	8E-06	2836.9	6E-06	1418.4	3E-06
NTX1497R_I	117	5.52	118.09	0.030	0.93	1418.4	5673.7	0.0004	4255.3	0.0003	2836.9	0.0002	1418.4	9E-05
NTX1498R_I	160	13.74	126.01	0.011	0.93	1418.4	5673.7	6E-05	4255.3	4E-05	2836.9	3E-05	1418.4	1E-05
NTX1510R_I	118	17.89	128.3	0.009	0.93	1418.4	5673.7	3E-05	4255.3	3E-05	2836.9	2E-05	1418.4	8E-06
NTX1616R_I	120	26.23	131.63	0.006	0.93	1418.4	5673.7	2E-05	4255.3	1E-05	2836.9	8E-06	1418.4	4E-06
NTX1635R_I	130	28.64	132.39	0.006	0.93	1418.4	5673.7	1E-05	4255.3	1E-05	2836.9	7E-06	1418.4	3E-06
NTX1702R_I	100	21.20	129.78	0.008	0.93	1418.4	5673.7	2E-05	4255.3	2E-05	2836.9	1E-05	1418.4	6E-06
NTX1704R_I	145	17.38	128.05	0.009	0.93	1418.4	5673.7	4E-05	4255.3	3E-05	2836.9	2E-05	1418.4	9E-06
NTX1705R_I	100	13.14	125.62	0.013	0.93	1418.4	5673.7	6E-05	4255.3	5E-05	2836.9	3E-05	1418.4	2E-05
NTX1707R_I	62	2.11	109.72	0.083	0.93	1418.4	5673.7	0.0024	4255.3	0.0018	2836.9	0.0012	1418.4	0.0006
NTX1812R_I	140	8.60	121.94	0.019	0.93	1418.4	5673.7	0.0001	4255.3	0.0001	2836.9	7E-05	1418.4	4E-05
Total Aggregated Received Signal Levels - milliwatts								0.0364		0.0273		0.0182		0.0091
Total Aggregated Received Signal Levels - dBm								**-14.38**		**-15.63**		**-17.39**		**-20.41**
Maximum Signal Level to Protect **15 dB S/N** - dBm/5 MHz								-35.32		-36.57		-34.57		-34.57
Adjusted for Number of 5 MHz Carriers - dBm								-29.30		-31.80		-31.56		-34.57
Degradation of 15 dB S/N - dB								**14.91**		**16.16**		**14.16**		**14.16**
Maximum Signal Level to Protect **19 dB S/N** - dBm/5 MHz								-40.32		-41.57		-38.57		-38.57
Adjusted for Number of 5 MHz Carriers - dBm								-34.30		-36.80		-35.56		-38.57
Degradation of 19 dB S/N - dB								**19.91**		**21.16**		**18.16**		**18.16**

Test Report

Effects of Adjacent and Non-Contiguous Channel Interference on Existing MDS Upstream Data Transmission Service

Version 2
01/27/06

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Effects of Adjacent and Non-Contiguous Channel Interference on Existing MDS Upstream Data Transmission Service

Objective: An existing deployment of two-way broadband wireless access systems in the United States employs a FDD system utilizing MMDS (2500MHz - 2686MHz) frequencies for downstream data transmission, and MDS (2150MHz - 2162MHz) frequencies for upstream data transmission. Recently, the FCC proposed to auction spectrum adjacent to MDS1 and MDS2 channels for use as Advanced Wireless Services (AWS). The proposed AWS downstream spectrum (2110MHz - 2155MHz) lies adjacent to and overlaps the existing broadband wireless service upstream spectrum.

The objective of this test is to investigate the effects of the proposed adjacent channel interference to the existing MDS1 data transmission service and determine the level of adjacent channel power that can be tolerated by the existing equipment configuration.

Methodology: The current configuration of the Sprint/Nextel MDS (2150-2162) upstream data system employs an Axcera model 6060A LNA and an Axcera model 5041 / 5072 MDS receiver to deliver a 44 MHz IF signal to a QPSK demodulator. The existing MDS1 QPSK upstream signals each occupy approximately 200 kHz bandwidth. The proposed AWS downstream spectrum is offered in 5 and 10 MHz blocks as indicated in Figure 4. Various combinations of adjacent channel carriers were simulated, ranging from a fully loaded AWS downstream spectrum (less the overlapping upper 5 MHz of Block F that would be co-channel with MDS1) to only a single signal located at Block A (farthest away in frequency from MDS1). Seven available 64-QAM signals, normally intended for 6 MHz channel increments, were used to simulate the proposed AWS downstream spectrum as shown in figure 4. While this simulation does not precisely emulate the 5 MHz increments of the proposed AWS block spacing, it is close enough to illustrate the relative impairment due to a fully loaded spectrum versus cases with fewer interfering channels occupied. In particular, as the closest frequency block signals are removed, the system can tolerate higher levels of interfering signals in the more distant frequency blocks.

As the relative levels of interfering adjacent channel signals are increased, progressively more intermodulation and crossmodulation distortion (undesired) products occur in the receiver and are converted down to appear in the IF spectrum along with the (desired) QPSK signal that is presented to the demodulator in the existing deployments. The interfering signals exhibit noise-like spectral characteristics and are of substantially wider bandwidth than the QPSK upstream signal. The resulting intermodulation and crossmodulation distortion appears as an apparent increase in receiver IF noise floor.

An available 400 kHz bandwidth QPSK signal was used to simulate the 200 kHz bandwidth QPSK signal employed in the actual upstream data transmission system. The use of the wider bandwidth QPSK signal does not affect the outcome of the test as the S/N comparison of the IF spectrum was performed using a spectrum analyzer resolution bandwidth of 30 kHz.

The test system is described in figure 1. Two S/N thresholds of interest were defined for this test. Field experience indicates that approximately 20 dB S/N or higher at the QPSK demodulator provides acceptable symbol error rates. Similarly, 15 dB S/N or lower at the QPSK demodulator results in poor to unusable quality symbol error rates.

The test system delivers a QPSK (400 kHz BW) signal at MDS1 center frequency (2153 MHz) at a level of –92dBm (or –103 dBm/30 kHz) to the input of the 6060A LNA. This level was selected to represent the lowest received upstream level for acceptable operation; it represents the sum of thermal noise floor plus approximate system noise figure plus 20 dB, to approximate the 20dB desired-to-undesired ratio condition at the receiver IF output. The desired-to-undesired ratio (dB) was observed at the IF (44 MHz) output of the 5041 receiver to determine the effects of changing interference carrier levels.

The seven interfering signals described above and in figure 4 were introduced at frequencies adjacent to and below MDS1 (2108 – 2150 MHz). The seven signals were normalized to equivalent levels. An attenuator following the combiner of the interfering carriers was adjusted to increase the interference level to degrade the IF S/N from 20 dB to 19 dB and the level was recorded. The attenuator was reduced further to increase the interference effect to degrade the IF S/N to 15 dB and the level was recorded.

The test was repeated again with the closest frequency interfering signal removed. This was repeated again with the next closest frequency interfering signal also removed. Similarly, the test was repeated each time removing another interfering signal until the last test condition employed only the lowest frequency interfering signal. The results are summarized in figure 2 for 19 dB S/N and figure 3 for 15 dB S/N. The charted results are levels observed in a 30 kHz resolution bandwidth.

Interfering signals of 5 MHz bandwidth would be higher level than shown by the bandwidth ratio of dB=10*log (5 MHz/30 kHz) or 22 dB higher than the levels displayed on the charts.

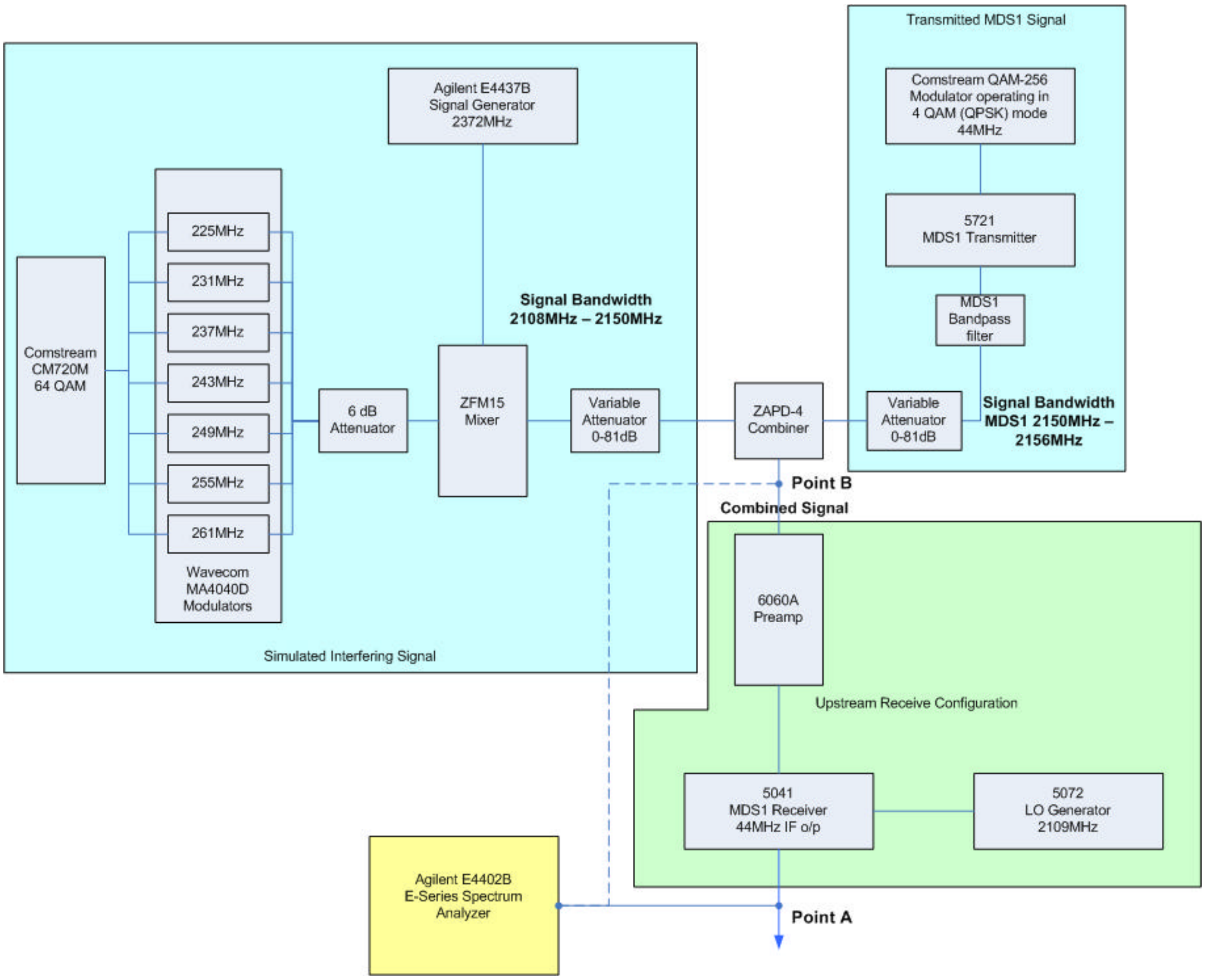

Figure 1. (Test System)

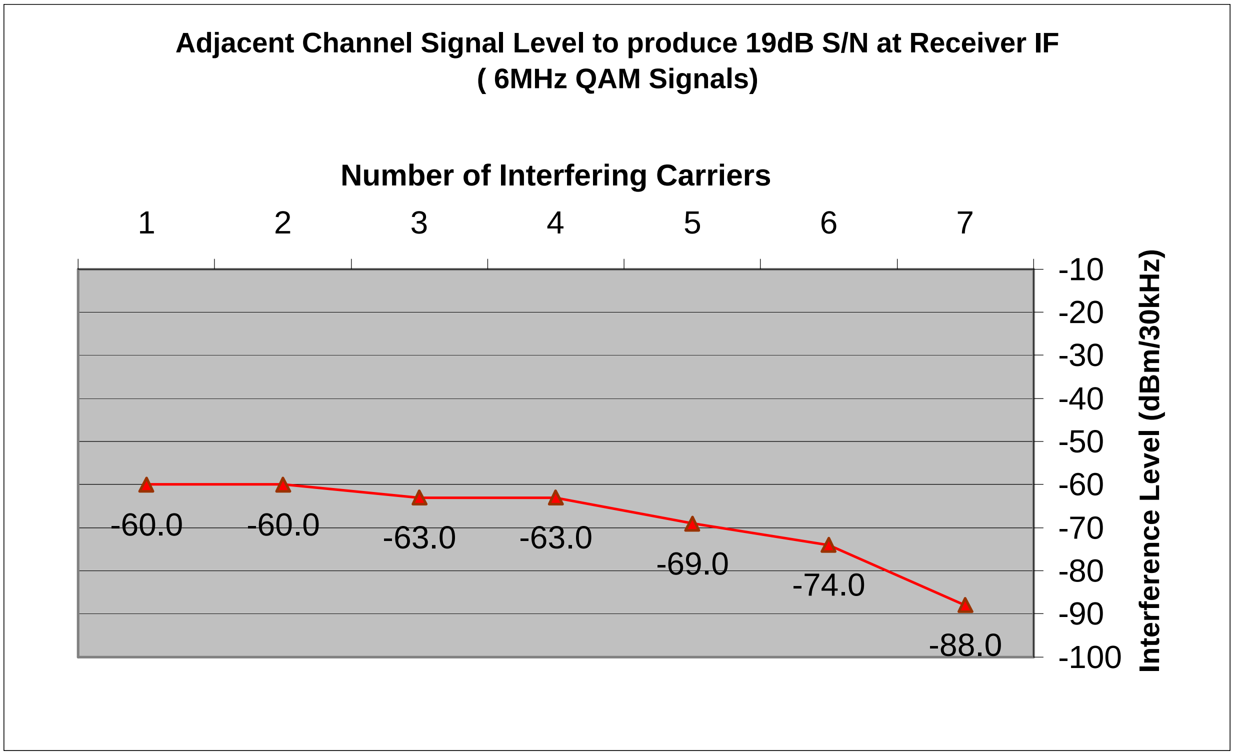

Figure 2.

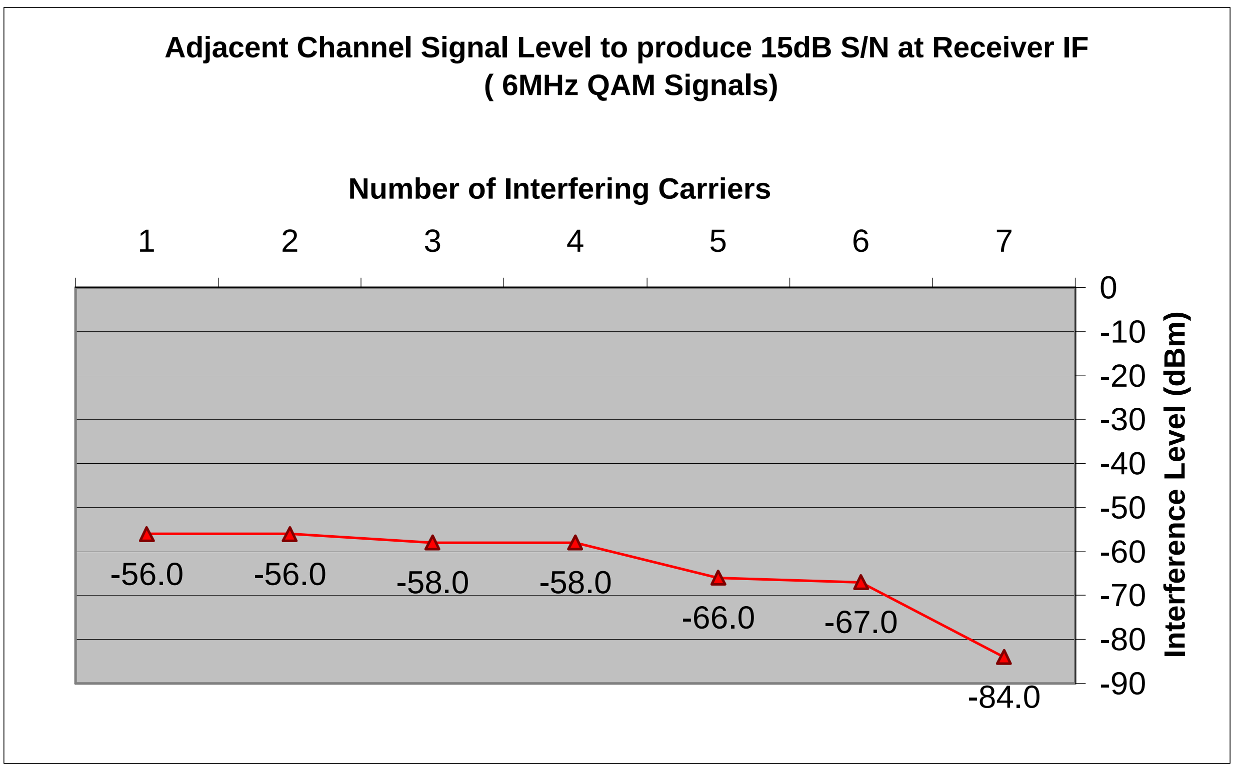

Figure 3.

Simulated Adjacent Channel Interference Spectrum
vs.
AWS Downstream Spectrum Plan

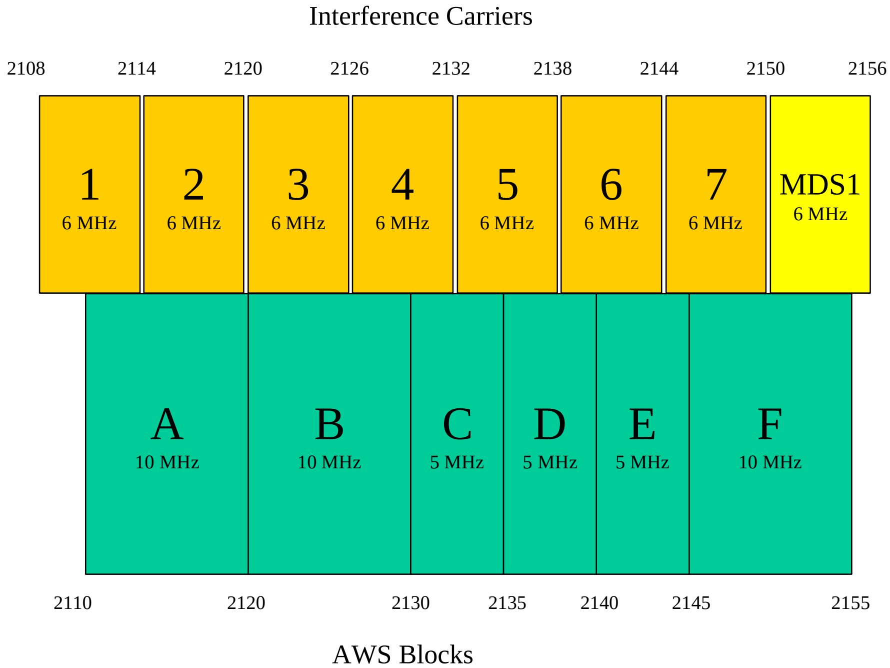

Figure 4.