Feasibility of Adjacent Channel Sharing between DARS and WCS

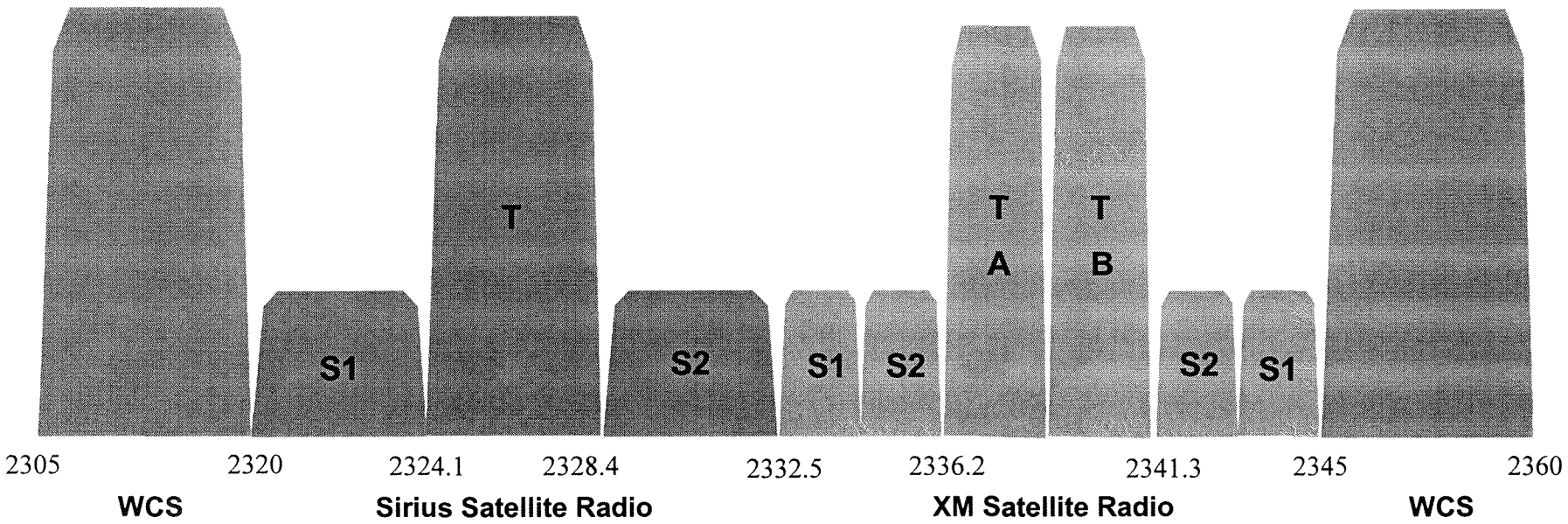
Presented by XM Radio to
Federal Communications Commission
Office of Engineering and Technology
March 1, 2002

Key Points

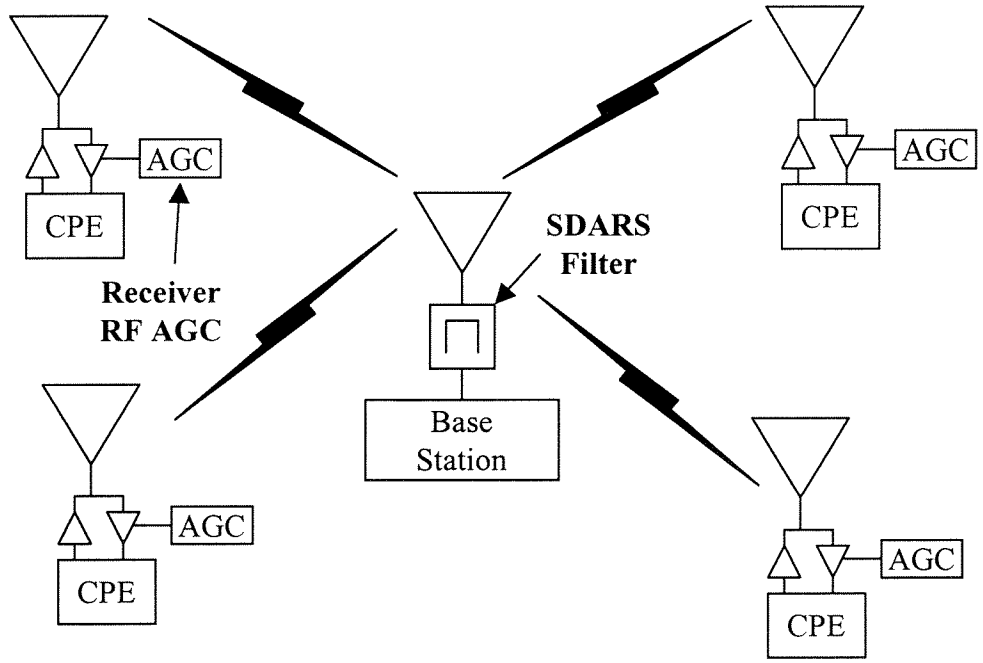
- WCS licensees can build equipment that, at little or no incremental cost, can operate with no degradation in performance in the presence of the XM and Sirius repeater networks

- Requiring XM and Sirius to eliminate higher power repeaters will add huge unnecessary cost to DARS repeater networks, ruin system performance, and actually *increase* interference to improperly designed WCS systems

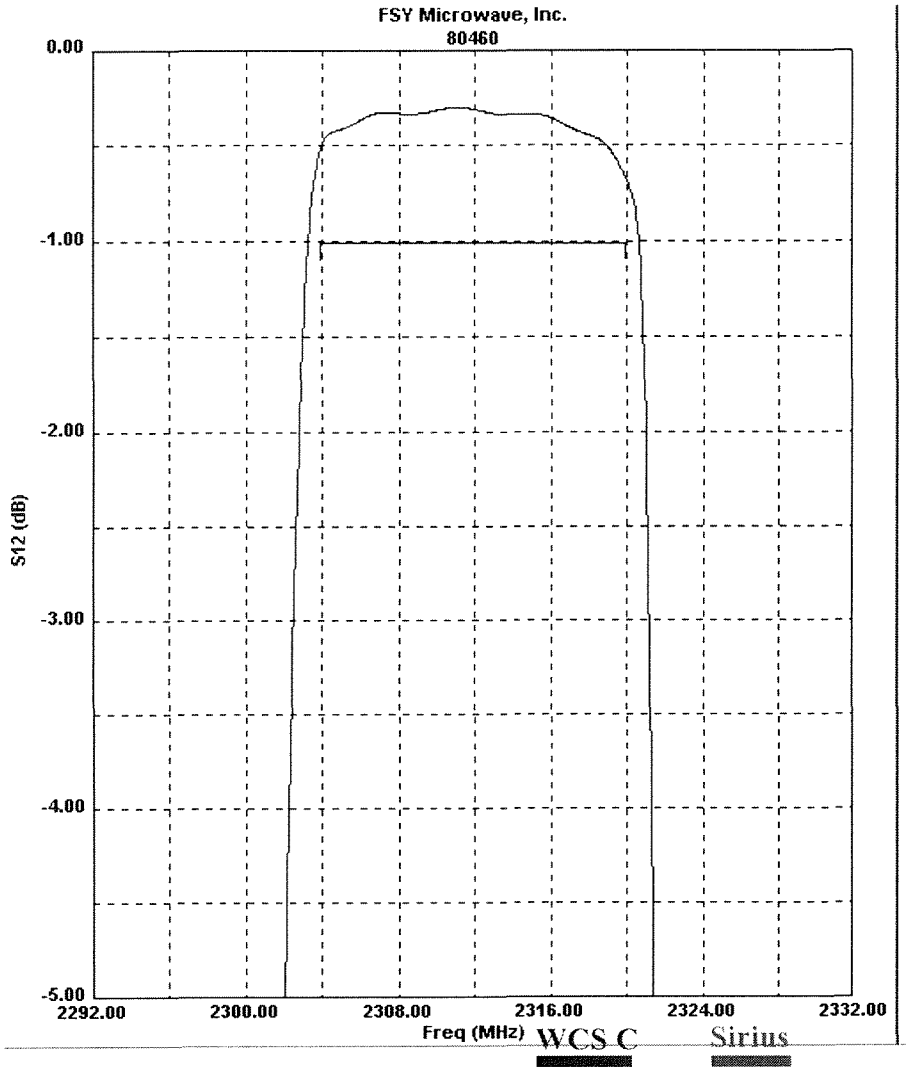
SDARS / WCS Spectrum

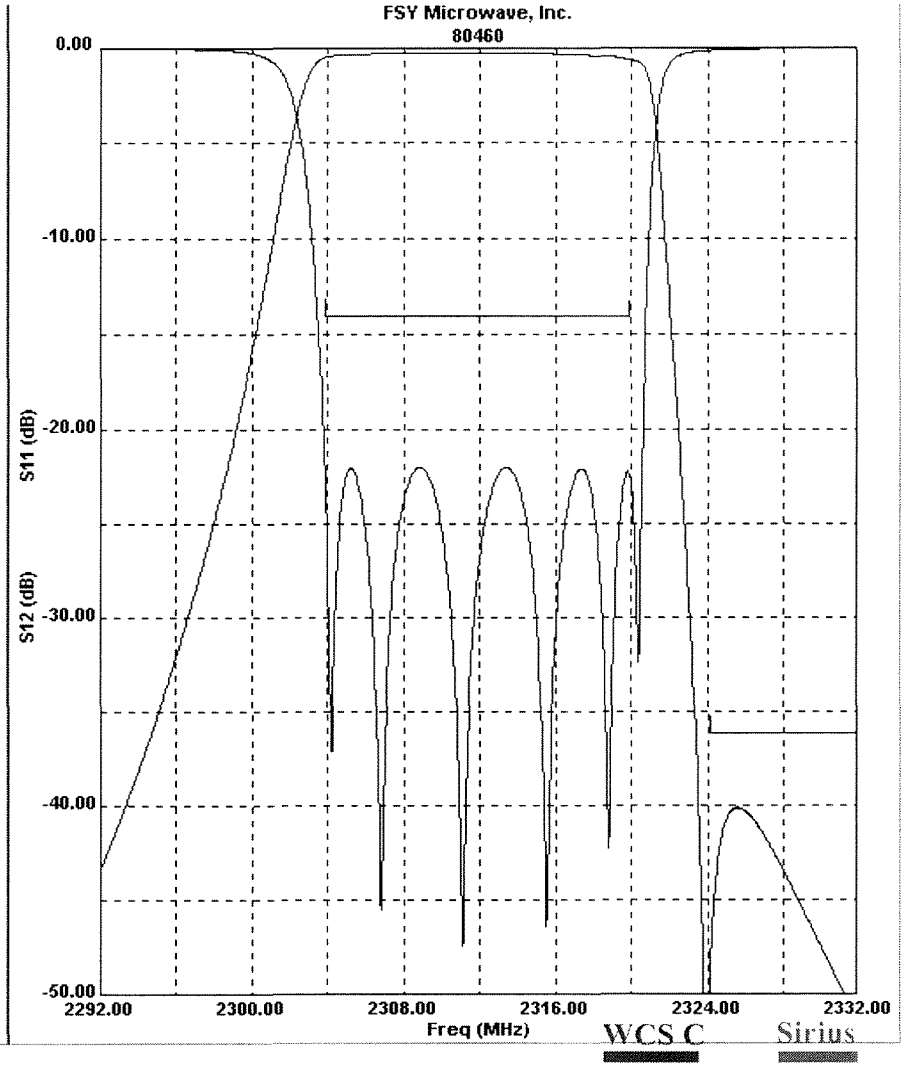


Proposed WCS RF System Diagram



Proposed Base Station Receive Filter Response for Lower WCS A, B and C Blocks

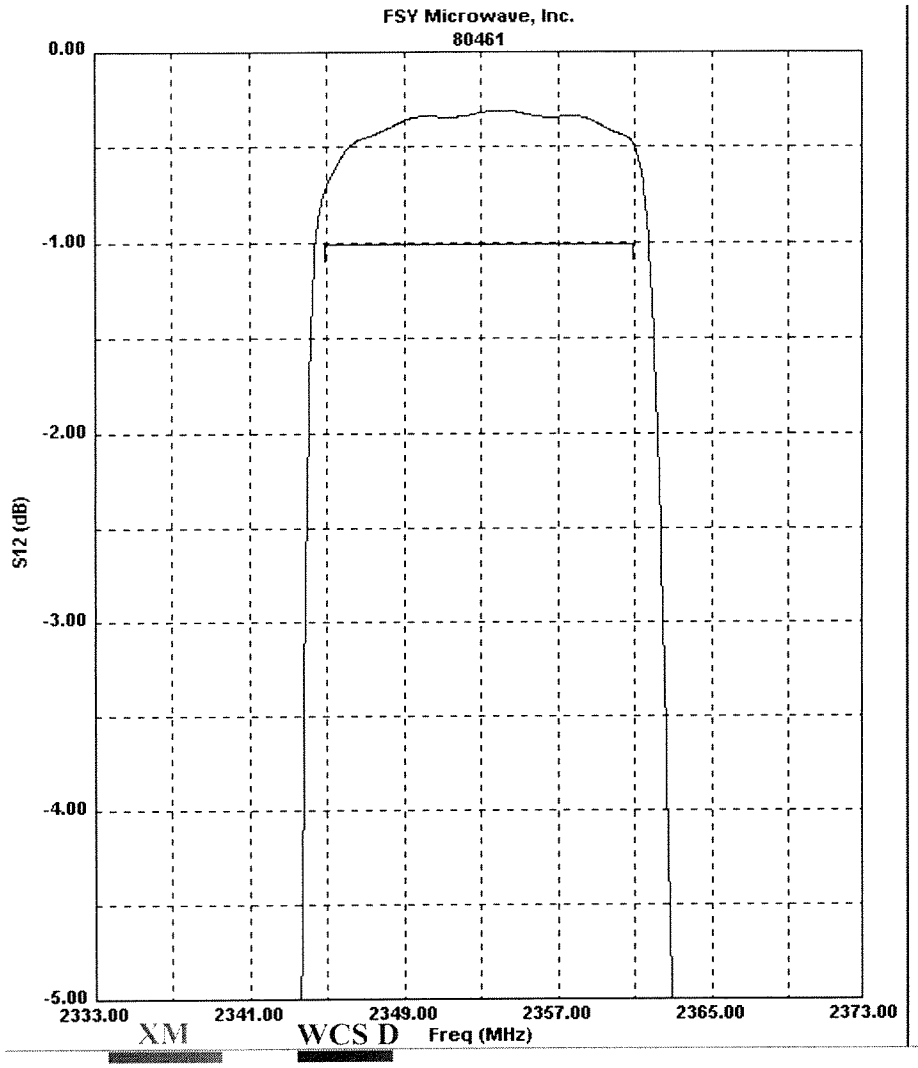


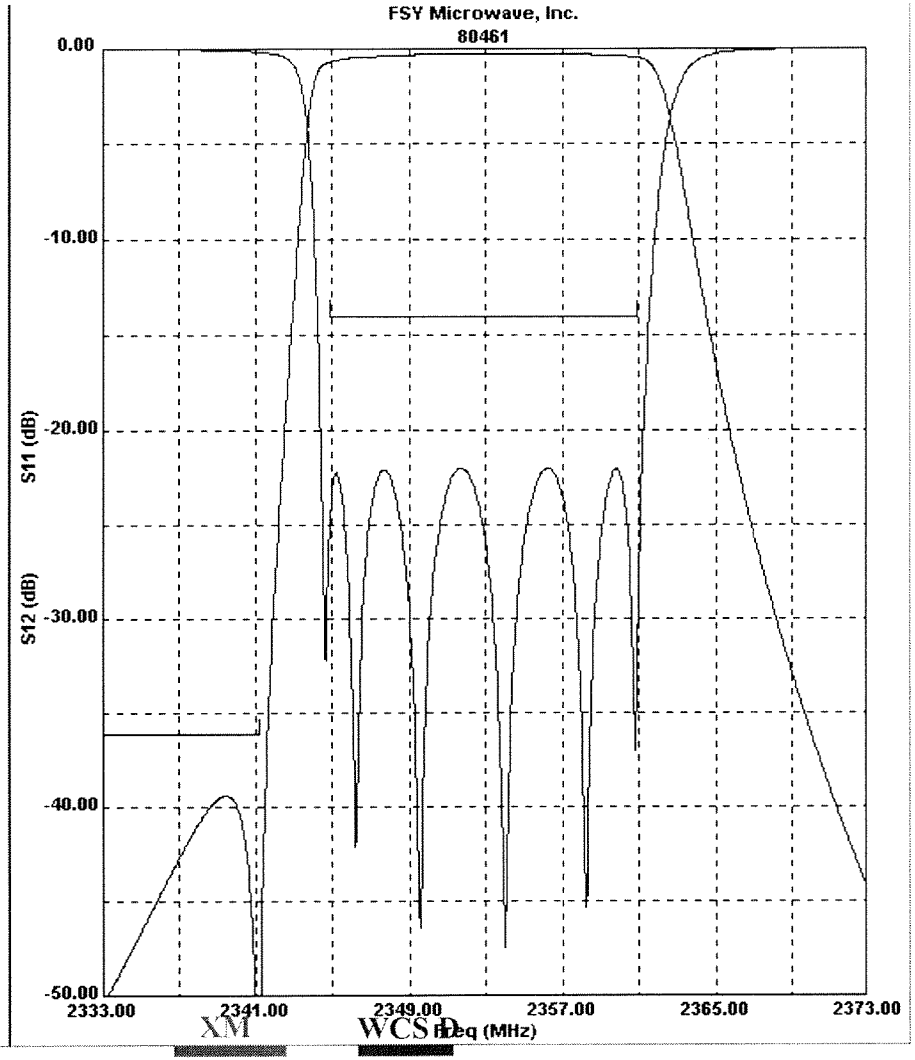


FSY Microwave, Inc., P/N: 80460, September 07, 2001

XM Radio Inc., White Paper Supplement, p. 19 (Sept. 24, 2001)

Proposed Base Station Receive Filter Response for Upper WCS A, B and D Blocks

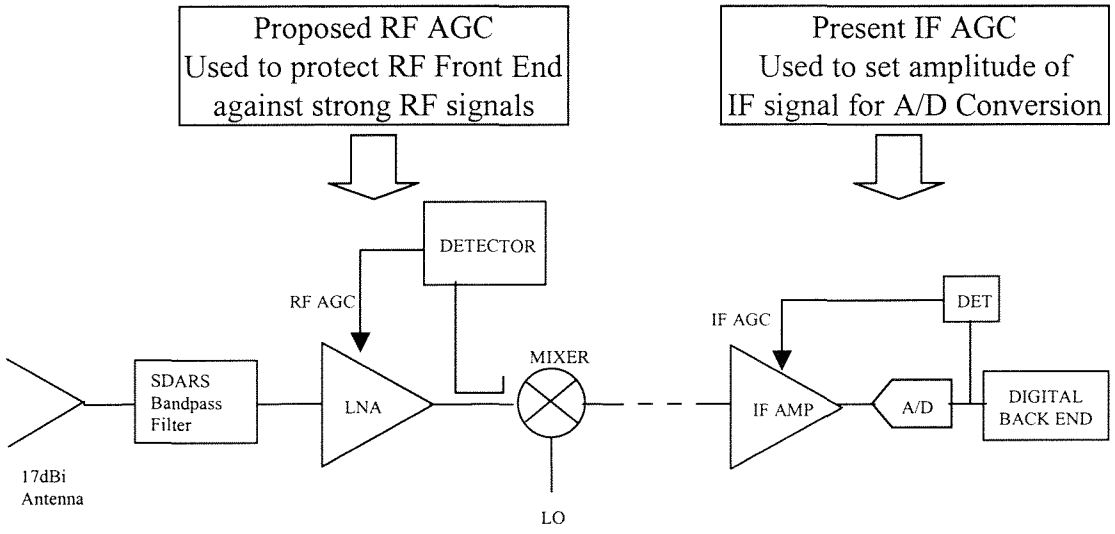




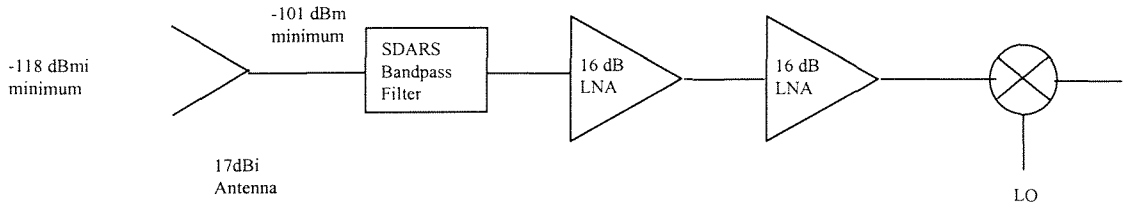
FSY Microwave, Inc., P/N: 80461, September 07, 2001

XM Radio Inc., White Paper Supplement, p. 19 (Sept. 24, 2001)

Customer Unit
Front End RF AGC and Back End IF AGC



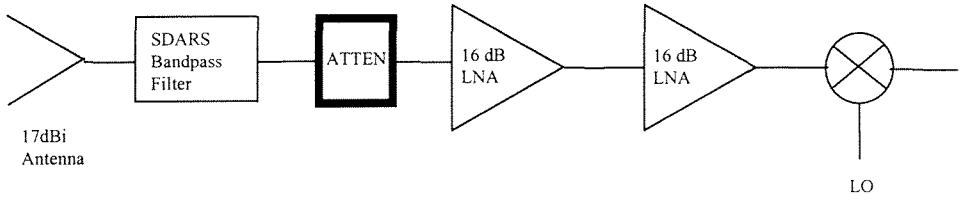
Customer Unit
Generic WCS Receiver Block Diagram and Performance



Performance at Input to SDARS Filter

Receiver	Sensitivity (dBm)	Overload (dBm)	Intermod (dBm)
RU – Generic	-94	-35	-43

Customer Unit
WCS Receiver Block Diagram and Performance with Front End Attenuation



Performance at Face of 17 dBi Antenna

Receiver with Antenna	Attenuation (dB)	Sensitivity (dBmi)	Overload (dBmi)	Intermod (dBmi)
RU – 1	0	-111	-52	-60
RU – 2	10	-101	-42	-50
RU – 3	20	-91	-32	-40
RU – 4	30	-81	-22	-30
RU – 5	40	-71	-12	-20
RU – 6	50	-61	-2	-10
RU – 7	60	-51	+8	0

CPE Performance Analysis with RF AGC

SDARS EIRP (WATTS)	WCS EIRP (WATTS)	WCS CELL SIZE (Mi)	WCS RCVR DISTANCE FROM BASE (Mi)	SDARS INTERFERING PATH LENGTH (Mi)	WCS RECEIVE LEVEL (dBm)	WCS EXCESS LINK MARGIN (dB)	SDARS SIGNAL AT RECEIVER (dBm)	DIFFERENCE BETWEEN SDARS AND WCS (dB)	AGC WORKS FOR OVERLOAD WITHOUT IMACTING PERFORMANCE	AGC WORKS FOR IM WITHOUT IMACTING PERFORMANCE
40,000	3.6	5	5	5	-61	19	-25.0	35.5	YES	YES
		5	2	2	-53	27	-17.0	35.5	YES	YES
		5	1	1	-47	33	-11.0	35.5	YES	YES
		5	5	15	-61	19	-34.5	26.0	YES	YES
		5	1	11	-47	33	-31.8	14.7	YES	YES
		5	5	65	-61	19	-47.3	13.3	YES	YES
20,000	3.6	5	5	5	-61	19	-28.0	32.5	YES	YES
		5	2	2	-53	27	-20.0	32.5	YES	YES
		5	1	1	-47	33	-14.0	32.5	YES	YES
		5	5	15	-61	19	-37.5	23.0	YES	YES
		5	5	65	-61	19	-50.3	10.3	YES	YES
10,000	3.6	5	5	5	-61	19	-31.0	29.5	YES	YES
		5	2	2	-53	27	-23.0	29.5	YES	YES
		5	1	1	-47	33	-17.0	29.5	YES	YES
		5	5	65	-61	19	-53.3	7.3	YES	YES
5,000	3.6	5	5	5	-61	19	-34.0	26.5	YES	YES
		5	2	2	-53	27	-26.0	26.5	YES	YES
		5	5	15	-61	19	-43.5	17.0	YES	YES
		5	1	11	-47	33	-40.8	5.7	YES	YES
2,000	3.6	5	5	5	-61	19	-38.0	22.5	YES	YES
		5	1	1	-47	33	-24.0	22.5	YES	YES
		5	5	15	-61	19	-47.5	13.0	YES	YES
		5	1	11	-47	33	-44.8	1.7	YES	YES
		5	5	65	-61	19	-60.3	0.3	YES	YES

Based on BellSouth Theoretical Receiver Performance

XM Radio Inc., Ex Parte Presentation, p. 6 (December 21, 2001)

Field Tests Validate this Analysis

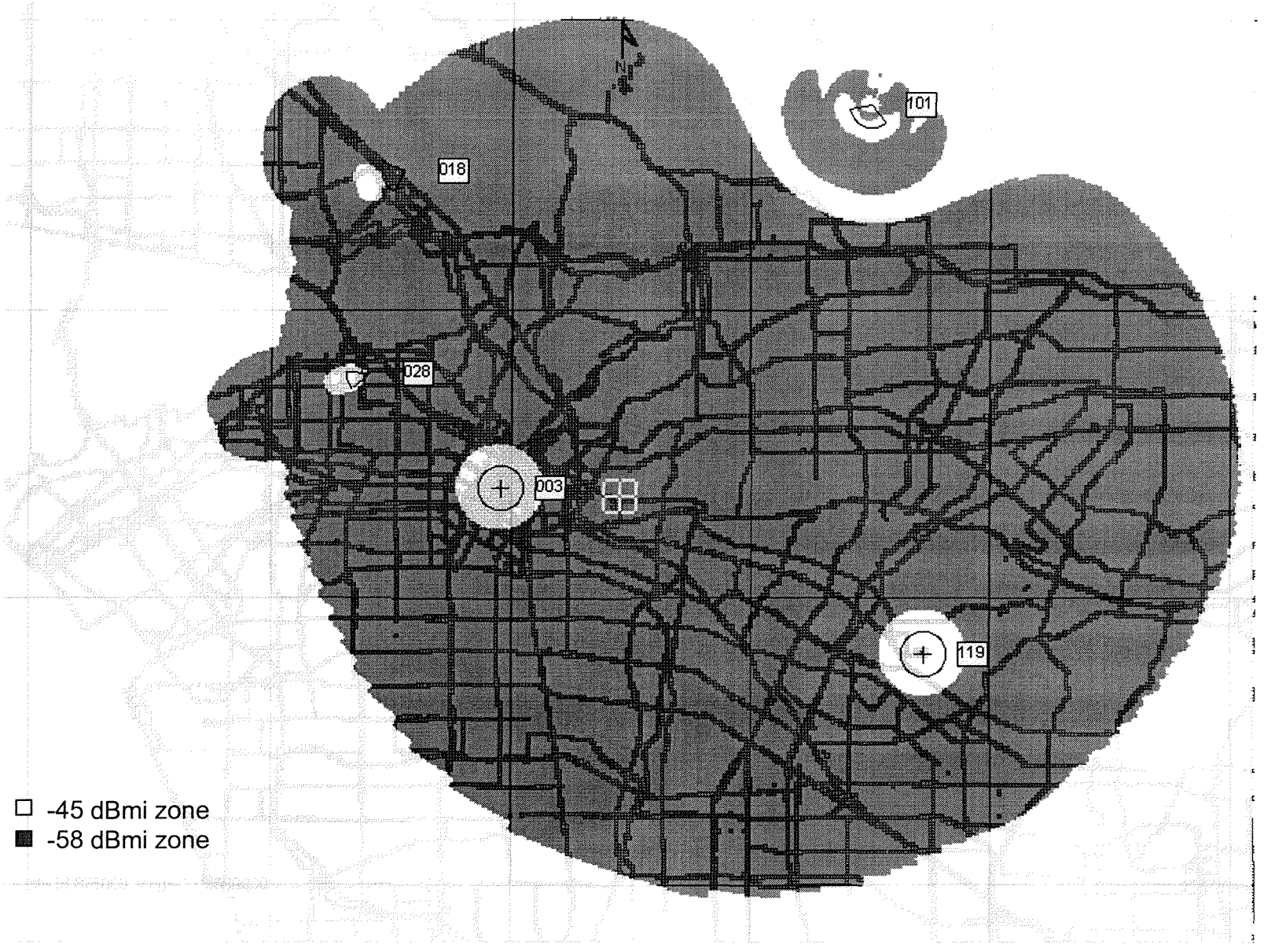
- In Houston, the WCS free space propagation model predicted blanketing interference for a WCS CPE operating within a distance of **11.4 MILES** from the XM high power repeater operating at Houston site 15B.
- Actual field test results demonstrated the WCS CPE could operate as close as across the street and in line-of-sight of the antenna at Houston site 15B with no degradation in performance.
- Using the free space propagation model and no antenna pattern discrimination is inappropriate.

This Analysis is Consistent with the Recent Channel 52-59 (Lower 700 MHz) Decision

- Lower power Part 27 (WCS) equipment can tolerate up to 3000 microwatts per square meter power flux density (among other things, 1dB noise floor increase for interference threshold is "unreasonable and overly restrictive")

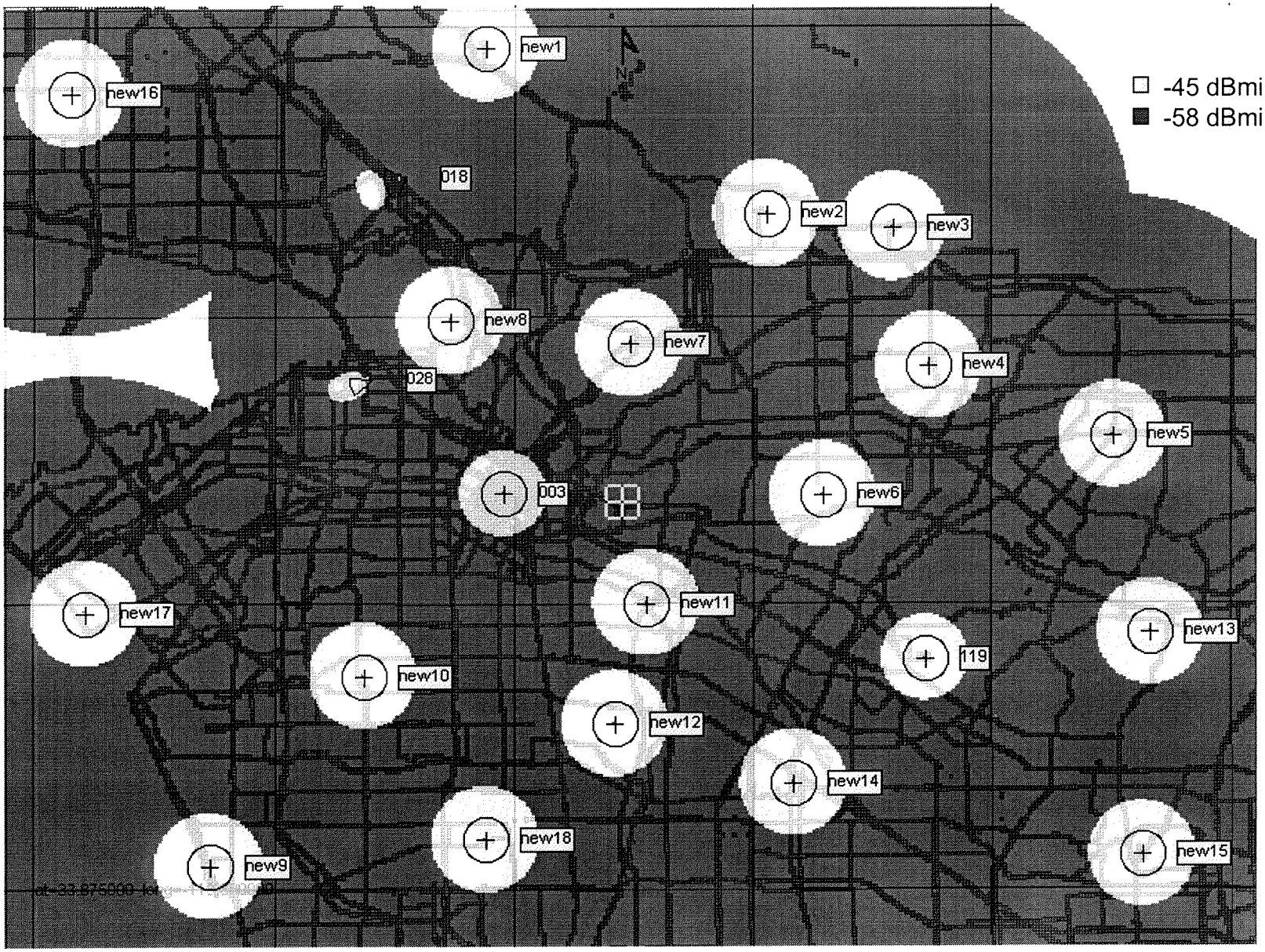
- Disparate power levels between systems in the same band is common practice

Hypothetical Exclusion Zones for Design with Higher Power Repeaters



XM Radio Inc. White Paper, (August 29, 2001)

Hypothetical Exclusion Zones for Design with Low Power



XM Radio Inc. White Paper, (August 29, 2001)

Comparison

	-45dBmi Exclusion Zone Area Based on Freespace + RMD
Current Design configuration: 1 25 kW EIRP site with panel antenna 2 1.2 kW EIRP sites with omni antennas 1 4.5 kW EIRP site with panel antenna 1 3.4 kW EIRP site with panel antenna	20 square miles
Low Power Design configuration: 18 2 kW EIRP sites with omni antennas 2 1.2 kW EIRP sites with omni antennas 1 2 kW EIRP site with panel antenna 1 2 kW EIRP site with panel antenna	159 square miles

Impact of a Requirement to power down

	Scenario A	Scenario B *	Scenario C
No of addl repeaters	0	10	900
Cost of network redeployment	0	3 mil	180 mil
Increased operating cost /yr	0	240k	22 mil
Time to complete	2 weeks	12 months	3 years
Impact on service	Minimum	Substantial degradation	Major degradation

Scenario A power cap of 30 kW, except for 20 grand fathered sites

Scenario B power cap of 18 kW

Scenario C power cap of 2 kW

* The impact would be substantially more for Sirius