Interference Analysis Report

An Assessment of the Impact of Radiolocation Systems Operating in 3.1-3.7 GHz Band on Fixed Satellite Services Earth Station Receiver

Prepared for

Loral Spacecom Corporation dba Loral Skynet

TRANSMIT-RECEIVE EARTH STATION (13.0 METER)

FCC CALL SIGN: E980250

Site Name: Kapolei, Hawaii

Prepared By

February 8, 2005

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1.0 Introduction

Interference calculations were performed to determine the potential for in-band and out-of-band interference from Radiolocation Systems operating in the 3.1 to 3.7 GHz band[1]. The geographical positions and operating parameters of these systems was derived from NTIA Document TR-99-361[2].

2.0 Radiolocation Systems in the 3.1 – 3.7 GHz Band

High powered mobile and fixed radar systems operated by the Federal Government operate in the 3.1 – 3.7 GHz band. These radars are used to search for and track near-surface and high-altitude airborne projectiles, sea surveillance, and airborne objects. The NTIA report referenced above has identified the locations for two types of systems: land-based and shipboard based. Also included in the report are the operating characteristics of these radars. There are two prevalent types of shipboard radars, denoted as type A and Type B, and one type of ground-based radar. An Airborne System radar is also specified. This analysis will concern itself with interference from the ground based and shipboard based radars based upon the relative operating positions and parameters specified in the NTIA report.

A summary of the operating parameters for the shipboard and ground based radar systems is shown below:

Table 1 – Technical Characteristics of 3.1-3.7 GHz Radiolocation Systems

Characteristic	Shipboard System A	Shipboard System B	Ground Based System
Modulation	P0N	Q7N	P0N
Tuning Range (GHz)	3.5-3.7	3.1-3.5	3.1-3.4
Peak transmit Power (MW)	1	4	0.12
Pulse Width (μsec.)	1.0	3.5-51.2	10.75
Pulse Repetition Rate (kHz)	1.125	0.152-6.0	2793.3-5050.51
Duty Cycle (%)	0.001	0.8-2.0	0.041
Transmit 3-dB Bandwidth (MHz)	4,16.6	4	1,10
Antenna Type	Reflector	Phased Array	Phase Scan Array
Antenna Mainbeam Gain (dBi)	32	42	36
Antenna Centerline (m)	46	20	46

[1] This report is being provided as required under Footnote US 245.

[2] National Telecommunications and Information Administration, U.S. DEPARTMENT OF COMMERCE, NTIA Report TR 99-361, *TECHNICAL CHARACTERISTICS OF RADIOLOCATION SYSTEMS OPERATING IN THE 3.1-3.7 GHz BAND AND PROCEDURES FOR ASSESSING EMC WITH FIXED EARTH STATION RECEIVERS,* (December 1999).

3.0 Earth Station System Parameters

The Fixed Satellite Service Earth Station's operational parameters are shown in the Tables 2 and 3 below:

TABLE 2 - SATELLITE EARTH STATION PARAMETERS AND COORDINATION DATA

SATELLITE EARTH STATION
FREQUENCY COORDINATION DATA
02/04/2005

Company	Loral Spacecom Corp. dba Loral Skynet	
Earth Station Name, State	KAPOLEI, HI	
Call Sign	E980250	
Latitude (DMS) (NAD83)	21 20 12.6 N	
Longitude (DMS) (NAD83)	158 5 21.1 W	
Ground Elevation AMSL (Ft/m)	129.93 /	39.60
Antenna Centerline AGL (Ft/m)	49.54 /	15.10
Receive Antenna Type:	Vertex Corporation 13 KPC	
4.0 GHz Gain (dBi) / Diameter (m)	53.3 /	13.0
3 dB / 15 dB Half Beamwidth	0.09 /	0.17
Transmit Antenna Type:	Vertex Corporation 13 KPC	
6.0 GHz Gain (dBi) / Diameter (m)	56.3 /	13.0
3 dB / 15 dB Half Beamwidth	0.06 /	0.12
Operating Mode	TRANSMIT AND RECEIVE	
Modulation	DIGITAL	
Emission / Receive Band (MHz)	36M0G7W / 3700.0000 -	4200.0000
	1M00N0N / 4199.0000	
	36M0F9W / 3700.0000 -	4200.0000
	360KG7W / 3700.0000 -	4200.0000
	350KG1D / 3722.1750	
	960KF2D / 4199.0000	
Emission / Transmit Band (MHz)	36M0G7W / 5925.0000 -	6425.0000
	960KF2D / 6425.0000	
	36M0F9W / 5925.0000 -	6425.0000
	360KG7W / 5925.0000 -	6425.0000
	350KG1D / 5947.1750	
	1M00N0N / 5925.0000 -	6425.0000
Max. Available RF Power (dBW)/4 kHz)	-0.50	
(dBW)/MHz)	23.50	
Max. EIRP (dBW)/4 kHz)	55.80	
(dBW)/MHz)	79.80	
Max permissible Interference Power		
4.0 GHz, 20% (dBW/1 MHz)	-156.0	
4.0 GHz, 0.0100% (dBW/1 MHz)	-146.0	
6.0 GHz, 20% (dBW/4 kHz)	-151.0	
6.0 GHz, 0.0025% (dBW/4 kHz)	-128.0	
Range of Satellite Arc (Geostationary)		
Degrees Longitude	214.0 W / 232.0 W	
Azimuth Range (Min/Max)	256.2 /	264.0
Corresponding Elevation Angles	23.5 /	6.3
Radio Climate	A	
Rain Zone	4	
Max Great Circle Coordination Distance (Mi/Km)		
4.0 GHz	408.9 /	658.2
6.0 GHz	232.6 /	374.4
Precipitation Scatter Contour Radius (Mi/Km)		
4.0 GHz	259.9 /	418.4
6.0 GHz	62.1 /	100.0

Note: Horizon is less than 0.2 degrees at all azimuths

Table of Earth Station Coordination Values
02/04/2005

Earth Station Name KAPOLEI HI
Owner Loral Spacecom Corp. dba Loral Skynet
Latitude (DMS) (NAD83) 21 20 12.6 N
Longitude (DMS) (NAD83) 158 5 21.1 W
Ground Elevation (Ft/m) 129.93 / 39.60 AMSL
Antenna Centerline (Ft/m) 49.54 / 15.10 AGL
Antenna Model Vertex 13 KPC
Objectives: Receive -156.0 (dBW /1 MHz)
Transmit -151.0 (dBW /4 kHz) TX Power -0.5 (dBW/4 kHz)

Azimuth (Deg)	Horizon Elevation Angle (Deg)	Antenna Disc. Angle (Deg)	4.0 GHz Antenna Gain (dBi)	4.0 GHz Coordination Distance (Km)	6.0 GHz Antenna Gain (dBi)	6.0 GHz Coordination Distance (Km)
0	0.00	95.96	-10.00	285.2	-10.00	165.9
5	0.00	100.93	-10.00	285.2	-10.00	165.9
10	0.00	105.89	-10.00	285.2	-10.00	165.9
15	0.00	110.86	-10.00	285.2	-10.00	165.9
20	0.00	115.82	-10.00	285.2	-10.00	165.9
25	0.00	120.78	-10.00	285.2	-10.00	165.9
30	0.00	125.74	-10.00	285.2	-10.00	165.9
35	0.00	130.69	-10.00	285.2	-10.00	165.9
40	0.00	135.63	-10.00	285.2	-10.00	165.9
45	0.00	140.57	-10.00	285.2	-10.00	165.9
50	0.00	145.40	-10.00	285.2	-10.00	165.9
55	0.00	148.78	-10.00	285.2	-10.00	165.9
60	0.00	151.74	-10.00	285.2	-10.00	165.9
65	0.00	154.12	-10.00	285.2	-10.00	165.9
70	0.00	155.75	-10.00	285.2	-10.00	165.9
75	0.00	156.47	-10.00	285.2	-10.00	165.9
80	0.00	156.21	-10.00	285.2	-10.00	165.9
85	0.00	154.98	-10.00	285.2	-10.00	165.9
90	0.00	152.93	-10.00	285.2	-10.00	165.9
95	0.00	150.22	-10.00	285.2	-10.00	165.9
100	0.00	147.02	-10.00	285.2	-10.00	165.9
105	0.00	143.45	-10.00	285.2	-10.00	165.9
110	0.00	139.62	-10.00	285.2	-10.00	165.9
115	0.00	135.59	-10.00	285.2	-10.00	165.9
120	0.00	131.42	-10.00	285.2	-10.00	165.9
125	0.00	127.13	-10.00	285.2	-10.00	165.9
130	0.00	122.76	-10.00	285.2	-10.00	165.9
135	0.00	118.33	-10.00	285.2	-10.00	165.9
140	0.00	113.85	-10.00	285.2	-10.00	165.9
145	0.00	109.34	-10.00	285.2	-10.00	165.9
150	0.00	104.79	-10.00	285.2	-10.00	165.9
155	0.00	100.23	-10.00	285.2	-10.00	165.9
160	0.00	95.65	-10.00	285.2	-10.00	165.9
165	0.00	91.07	-10.00	285.2	-10.00	165.9
170	0.00	86.48	-10.00	285.2	-10.00	165.9
175	0.00	81.90	-10.00	285.2	-10.00	165.9
180	0.00	77.33	-10.00	285.2	-10.00	165.9

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Latitude (DMS) (NAD83) 21 20 12.6 N
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Antenna Model Vertex 13 KPC
Objectives: Receive -156.0 (dBW /1 MHz)
Transmit -151.0 (dBW /4 kHz) TX Power -0.5 (dBW/4 kHz)

Azimuth (Deg)	Horizon Elevation Angle (Deg)	Antenna Disc. Angle (Deg)	4.0 GHz Antenna Gain (dBi)	4.0 GHz Coordination Distance (Km)	6.0 GHz Antenna Gain (dBi)	6.0 GHz Coordination Distance (Km)
185	0.00	72.78	-10.00	285.2	-10.00	165.9
190	0.00	68.25	-10.00	285.2	-10.00	165.9
195	0.00	63.75	-10.00	285.2	-10.00	165.9
200	0.00	59.29	-10.00	285.2	-10.00	165.9
205	0.00	54.89	-10.00	285.2	-10.00	165.9
210	0.00	50.57	-10.00	285.2	-10.00	165.9
215	0.00	46.34	-9.65	287.5	-9.65	168.9
220	0.00	42.15	-8.62	294.2	-8.62	172.9
225	0.00	37.85	-7.45	302.0	-7.45	177.4
230	0.00	33.46	-6.11	311.2	-6.11	182.6
235	0.00	29.00	-4.56	322.8	-4.56	188.6
240	0.00	24.48	-2.72	336.1	-2.72	195.6
245	0.00	19.92	-0.48	352.9	-0.48	204.2
250	0.00	15.34	2.36	374.9	2.36	213.6
255	0.00	10.98	5.98	403.8	5.98	229.2
260	0.00	7.47	10.16	440.4	10.16	248.5
265	0.00	6.39	11.86	658.1	11.86	374.3
270	0.00	8.70	8.52	425.7	8.52	241.1
275	0.00	12.66	4.44	391.0	4.44	222.4
280	0.00	17.16	1.13	365.3	1.13	208.8
285	0.00	21.88	-1.50	345.2	-1.50	200.3
290	0.00	26.70	-3.66	329.2	-3.66	192.0
295	0.00	31.57	-5.48	316.2	-5.48	185.0
300	0.00	36.47	-7.05	304.7	-7.05	179.0
305	0.00	41.39	-8.42	295.5	-8.42	173.6
310	0.00	46.33	-9.65	287.5	-9.65	168.9
315	0.00	51.27	-10.00	285.2	-10.00	165.9
320	0.00	56.23	-10.00	285.2	-10.00	165.9
325	0.00	61.19	-10.00	285.2	-10.00	165.9
330	0.00	66.15	-10.00	285.2	-10.00	165.9
335	0.00	71.11	-10.00	285.2	-10.00	165.9
340	0.00	76.08	-10.00	285.2	-10.00	165.9
345	0.00	81.05	-10.00	285.2	-10.00	165.9
350	0.00	86.02	-10.00	285.2	-10.00	165.9
355	0.00	90.99	-10.00	285.2	-10.00	165.9

4.0 Interference Calculations

The interference was calculated into the earth station receive system for both in-band and out-of-band interference. The interference power level was calculated using the formula below:

$$P_r = P_t + G_t - FSL - OHLOSS + G_{es} - LL_t - LL_{es}$$

Where:

P_r : Interference power level received at victim earth station, in dBW
P_t: Transmitter power of Radiolocation system, in dBW
G_t: Gain of Radiolocation transmit system, in dBi
FSL: Free Space Loss between radiolocation system and earth station, in dB
OHLOSS: Over-the-Horizon losses between radiolocation system and earth station, in dB
G_{es}: Horizon gain of the earth station toward radiolocation transmitter, in dBi
LL_t: Line losses of the radiolocation system, in dB (assume 2dB per NTIA report)
LL_{es}: Line losses of the earth station system, in dB (assume 0 dB unless known)

This interference power level was then compared to in-band and out-of-band interference criteria. The in-band criteria was developed using ITU and FCC recommendations[3]. The out-of-band interference criteria was developed using the following:

The earth station's low –noise amplifier front-end overload criteria of was determined using the following calculations:

$$T = C - G$$

Where:

T = input threshold at which front-end overload occurs, dBW
C = output 1 dB gain compression point of the LNA, typical -20 dBW
G = Gain of the LNA, dB

For the purposes of this report it was assumed that the low-noise amplifier would not provide any out-of-band frequency rejection, thus no Frequency Dependent Rejection values based upon any RF selectivity, such as pre-LNA filtering or inherent LNA filtering, have been assumed. The maximum level of interference is the includes the input saturation threshold value minus a 10 dB output backoff value to consider in operation levels

The maximum interference power receive, P_r, allowable then becomes:

$$\text{Max } P_r \geq T - IPBO$$

For a 65 dB gain LNA this value is -95 dBW. In the absence of manufacturer LNA/LNB specifications the following typical values have been used:

T = -95 dBW
C = -20 dBW
G = 65 dB

The propagation model to determine the over-the-horizon loss is the NSMA OH-Loss model[4]. When the propagation link is very lengthy, over 250 miles, an estimated OH-loss using a rounded earth modeling value has been used.

[3] FCC Rules 47CFR25.251 by reference ITU Radio Regulations Appendix S7.
[4] National Spectrum Managers Association has developed an industry accepted version which incorporates NBS Tech Note 101.

5.0 Summary of Results

The summary calculations are shown for all shipboard based and land based systems in Tables 4 through 8 below. Whenever Radar A and B are possibly in use, the interference calculations have assumed the higher powered systems (Radar B). The antenna elevation for the Ground Based systems was assumed to be 46 m even though it was not specified in the NTIA report.

Table 4 Shipboard Radar A Land-Based Test and Training Sites

Radar Location		Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?
Pensacola,	FL	302128	0871626	66.6	4454.7	NO	-180.8	-108.8	N/A	-289.6	-239.6	NO	NO
Pascagoula,	MS	302200	0882900	66.7	4380.0	NO	-180.6	-108.5	N/A	-289.2	-239.2	NO	NO
St.Inigoes,	MD	381000	0762300	56.4	5045.8	NO	-181.9	-111.0	N/A	-292.9	-242.9	NO	NO

Table 5 Shipboard Radar B Land-Based Test and Training Sites

Radar Location		Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?
Moorestown,	NJ	395849	0745630	54.3	5115.7	NO	-182.0	-111.2	N/A	-293.2	-227.2	NO	NO
Wallops Island,	VA	375600	0752800	56.6	5101.4	NO	-182.0	-111.2	N/A	-293.1	-227.1	NO	NO

Table 6 Shipboard Radars A and B Home Ports

Radar Location		Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?
Bath,	ME	435425	0694848	49.4	5377.7	NO	-182.4	-112.1	N/A	-294.5	-228.5	NO	NO
Bremerton,	WA	473324	1223811	38.2	2713.8	NO	-176.5	-100.2	N/A	-276.7	-210.7	NO	NO
Everett,	WA	475858	1221354	37.8	2746.8	NO	-176.6	-100.4	N/A	-277.0	-211.0	NO	NO
Mayport,	FL	302334	0812427	65.8	4816.4	NO	-181.5	-110.2	N/A	-291.6	-225.6	NO	NO
Norfolk,	VA	365200	0762100	57.9	5058.5	NO	-181.9	-111.0	N/A	-292.9	-226.9	NO	NO
Pascagoula,	MS	302253	0882933	66.6	4379.3	NO	-180.6	-108.5	N/A	-289.2	-223.1	NO	NO
Pearl Harbor,	HI	212000	1580000	92.4	5.8	YES	-123.0	0.0	0	-123.0	-57.0	YES	YES
Portland,	ME	434100	0701800	49.7	5352.2	NO	-182.4	-112.0	N/A	-294.4	-228.4	NO	NO
San Diego	CA	324105	1170800	63.5	2643.8	NO	-176.3	-99.7	-73.3	-276.0	-210.0	NO	NO

Table 7 Naval At-Sea Operational Areas

Operational Area	Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?
AFWTF (North Range)												
AFWTF (NR)1	183000	0670000	76.4	5929.4	NO	-183.3	-113.8	N/A	-297.1	-231.0	NO	NO
AFWTF (NR)2	200000	0670000	74.8	5898.4	NO	-183.2	-113.7	N/A	-296.9	-230.9	NO	NO
AFWTF (NR)3	221000	0654800	72.3	5932.3	NO	-183.3	-113.8	N/A	-297.1	-231.0	NO	NO
AFWTF (NR)4	221000	0652000	72.3	5962.3	NO	-183.3	-113.9	N/A	-297.2	-231.2	NO	NO
AFWTF (NR)5	185000	0620000	75.1	6247.3	NO	-183.7	-114.7	N/A	-298.4	-232.4	NO	NO
AFWTF (NR)6	185000	0620000	75.1	6247.3	NO	-183.7	-114.7	N/A	-298.4	-232.4	NO	NO
AFWTF (NR)7	182500	0643000	76.0	6093.7	NO	-183.5	-114.3	N/A	-297.8	-231.7	NO	NO
AFWTF (NR)8	183000	0644500	75.9	6075.7	NO	-183.5	-114.2	N/A	-297.7	-231.7	NO	NO
AFWTF (NR)9	183000	0663800	76.3	5953.2	NO	-183.3	-113.8	N/A	-297.2	-231.1	NO	NO
AFWTF (South Range)												
AFWTF (SR)1	180500	0675500	77.0	5878.4	NO	-183.2	-113.6	N/A	-296.8	-230.8	NO	NO
AFWTF (SR)2	180500	0652700	76.5	6039.0	NO	-183.4	-114.1	N/A	-297.5	-231.5	NO	NO
AFWTF (SR)3	181500	0651000	76.3	6053.9	NO	-183.5	-114.1	N/A	-297.6	-231.6	NO	NO
AFWTF (SR)4	181500	0641000	76.1	6119.0	NO	-183.6	-114.3	N/A	-297.9	-231.9	NO	NO
AFWTF (SR)5	170000	0641000	77.4	6146.0	NO	-183.6	-114.4	N/A	-298.0	-232.0	NO	NO
AFWTF (SR)6	165800	0642800	77.5	6127.2	NO	-183.6	-114.3	N/A	-297.9	-231.9	NO	NO
AFWTF (SR)7	153300	0660600	79.2	6051.3	NO	-183.5	-114.1	N/A	-297.6	-231.6	NO	NO
AFWTF (SR)8	153900	0662300	79.2	6030.6	NO	-183.4	-114.1	N/A	-297.5	-231.5	NO	NO
AFWTF (SR)9	163000	0662300	78.3	6012.1	NO	-183.4	-114.0	N/A	-297.4	-231.4	NO	NO
AFWTF (SR)10	163000	0675500	78.6	5911.9	NO	-183.3	-113.7	N/A	-297.0	-231.0	NO	NO

Table 7 Naval At-Sea Operational Areas (continued)

Operational Area	Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?
AUTEC												
AUTEC1	252000	0780500	71.1	5091.6	NO	-182.0	-111.1	N/A	-293.1	-227.1	NO	NO
AUTEC2	252000	0774500	71.0	5112.7	NO	-182.0	-111.2	N/A	-293.2	-227.2	NO	NO
AUTEC3	232500	0762000	72.9	5233.9	NO	-182.2	-111.6	N/A	-293.8	-227.8	NO	NO
AUTEC4	232500	0771500	73.0	5175.2	NO	-182.1	-111.4	N/A	-293.5	-227.5	NO	NO
FORACS, Hawaii												
FORACS, Hawaii1	212530	1581100	315.0	8.6	YES	-126.5	-91.3	-91.3	-217.8	-151.8	YES	NO
FORACS, Hawaii2	212100	1581500	275.0	10.4	YES	-128.2	0.0	0	-128.2	-51.0	YES	YES
FORACS, Hawaii3	211500	1580800	205.5	6.6	YES	-124.2	0.0	0	-124.2	-58.2	YES	YES
FORACS, Hawaii4	211500	1580700	196.5	6.2	YES	-123.7	0.0	0	-123.7	-57.7	YES	YES
Gulf of Mexico OPAREA												
GoM1	293601	0800130	66.6	4911.2	NO	-181.6	-110.5	N/A	-292.1	-226.1	NO	NO
GoM2	292521	0864800	67.6	4492.6	NO	-180.9	-109.0	N/A	-289.8	-223.8	NO	NO
GoM3	284101	0864800	68.5	4500.0	NO	-180.9	-109.0	N/A	-289.9	-223.8	NO	NO
GoM4	285231	0874400	68.4	4439.9	NO	-180.8	-108.8	N/A	-289.5	-223.5	NO	NO
Pacific Missile Range Facility (PMRF)												
PMRF1	220000	1594500	293.4	116.1	YES	-149.1	-56.7	-56.7	-205.8	-133.5	YES	NO
PMRF2	220800	1620000	283.0	257.3	NO	-156.0	-59.3	N/A	-215.3	-138.2	YES	NO
PMRF3	224500	1614000	293.6	249.2	YES	-155.8	-63.9	-63.9	-219.7	-147.3	YES	NO
PMRF4	260000	1581500	358.2	321.1	NO	-158.0	-63.1	N/A	-221.1	-145.0	YES	NO
Pearl Harbor South OPAREA												
PHS1	190800	1591500	206.6	169.3	YES	-152.4	-48.4	-48.4	-200.8	-134.8	YES	NO
PHS2	210000	1580800	187.0	23.3	YES	-135.2	0.0	0	-135.2	-69.2	YES	YES
PHS3	210000	1573600	126.2	39.2	YES	-139.7	-11.5	-11.5	-151.2	-85.2	YES	NO
PHS4	191800	1562000	140.6	180.6	YES	-153.0	-50.1	-50.1	-203.1	-137.0	YES	NO
PHS5	184900	1574500	172.7	174.7	YES	-152.7	-49.2	-49.2	-201.9	-135.8	YES	NO

Table 7 Naval At-Sea Operational Areas (continued)

Operational Area	Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?
Southern California (SOCAL)												
SOCAL1	385200	1255200	49.9	2276.5	NO	-175.0	-97.1	N/A	-272.1	-206.1	NO	NO
SOCAL2	390000	1240000	50.6	2375.6	NO	-175.3	-97.9	N/A	-273.2	-207.2	NO	NO
SOCAL3	311500	1163000	66.0	2669.6	NO	-176.3	-99.9	-72.8	-276.3	-210.2	NO	NO
SOCAL4	300000	1203000	67.6	2419.6	NO	-175.5	-98.2	N/A	-273.7	-207.7	NO	NO
Virginia Capes OPAREA												
VC1	384500	0750000	55.7	5121.8	NO	-182.0	-111.2	N/A	-293.2	-227.2	NO	NO
VC2	384500	0743000	55.6	5151.0	NO	-182.1	-111.3	N/A	-293.4	-227.4	NO	NO
VC3	374500	0724000	56.5	5267.5	NO	-182.3	-111.7	N/A	-294.0	-228.0	NO	NO
VC4	350600	0724000	59.5	5296.0	NO	-182.3	-111.8	N/A	-294.1	-228.1	NO	NO
VC5	320000	0771200	63.5	5057.0	NO	-181.9	-111.0	N/A	-292.9	-226.9	NO	NO
VC6	342400	0773000	60.8	5013.0	NO	-181.8	-110.9	N/A	-292.7	-226.7	NO	NO
VC7	354000	0752500	59.2	5125.3	NO	-182.0	-111.2	N/A	-293.3	-227.2	NO	NO
VC8	370000	0755000	57.7	5087.9	NO	-181.9	-111.1	N/A	-293.1	-227.0	NO	NO

Table 8 Land-Based Radar Test and Training Sites

Radar Location		Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?
Fort Lewis	WA	470525	1223510	38.9	2698.9	NO	-176.4	-100.1	N/A	-276.5	-210.5	NO	NO
Yakima Firing	WA	464018	1202135	40.6	2782.0	NO	-176.7	-100.6	N/A	-277.3	-211.3	NO	NO
Fort Carson	CO	383810	1044750	56.2	3410.5	NO	-178.5	-104.2	N/A	-282.6	-216.6	NO	NO
Fort Rliey	KS	385813	0965139	56.3	3861.3	NO	-179.6	-106.3	N/A	-285.9	-219.9	NO	NO
Fort Shafter	HI	211800	1574900	98.2	17.8	YES	-132.8	-7.0	-7	-139.8	-73.8	YES	YES
Hunter AAF	GA	320100	0810800	63.9	4816.2	NO	-181.5	-110.2	N/A	-291.6	-225.6	NO	NO
Fort Gillem	GA	333600	0841900	62.4	4608.9	NO	-181.1	-109.4	N/A	-290.5	-224.5	NO	NO
Fort Benning	GA	322130	0845815	64.0	4579.0	NO	-181.0	-109.3	N/A	-290.3	-224.3	NO	NO
Fort Stewart	GA	315145	0813655	64.2	4788.3	NO	-181.4	-110.1	N/A	-291.5	-225.5	NO	NO

Table 8 Land-Based Radar Test and Training Sites (Continued)													
Fort Rucker	AL	311947	0854255	65.2	4542.1	NO	-181.0	-109.1	N/A	-290.1	-224.1	NO	NO
Yuma Proving	AZ	330114	1141855	63.4	2813.0	NO	-176.8	-100.8	-72.8	-277.6	-211.6	NO	NO
Fort Hood	TX	310830	0974550	66.4	3805.6	NO	-179.4	-106.1	N/A	-285.5	-219.5	NO	NO
Fort Knox	KY	375350	0855655	57.5	4489.0	NO	-180.9	-108.9	N/A	-289.8	-223.8	NO	NO
Fort Bragg	NC	350805	0790035	60.1	4915.5	NO	-181.7	-110.5	N/A	-292.2	-226.1	NO	NO
Fort Campbell	KY	363950	0872820	59.0	4404.0	NO	-180.7	-108.6	N/A	-289.3	-223.3	NO	NO
Fort Polk	LA	310343	0931226	66.2	4084.8	NO	-180.0	-107.3	N/A	-287.3	-221.3	NO	NO
Fort Leonard	MO	374430	0920737	57.9	4130.4	NO	-180.1	-107.5	N/A	-287.6	-221.6	NO	NO
Fort Irwin	CA	351536	1164102	59.4	2699.7	NO	-176.4	-100.1	-68.1	-276.6	-210.5	NO	NO
Fort Sill	OK	344024	0982352	61.9	3762.0	NO	-179.3	-105.9	N/A	-285.2	-219.2	NO	NO
Fort Bliss	TX	314850	1062533	65.7	3278.5	NO	-178.1	-103.5	N/A	-281.6	-230.6	NO	NO
Fort Leavenworth	KS	392115	0945500	55.8	3973.1	NO	-179.8	-106.8	N/A	-286.6	-220.6	NO	NO
Fort Drum	NY	440115	0754844	49.7	5043.4	NO	-181.9	-111.0	N/A	-292.8	-226.8	NO	NO
Fort Gordon	GA	332510	0820910	62.4	4741.2	NO	-181.3	-109.9	N/A	-291.2	-225.2	NO	NO
Fort McCoy	WI	440636	0904127	50.0	4228.0	NO	-180.3	-107.9	N/A	-288.2	-222.2	NO	NO
Fort Dix	NJ	400025	0743713	54.2	5134.0	NO	-182.0	-111.3	N/A	-293.3	-227.3	NO	NO
Parks Reserve	CA	374254	1214218	53.8	2464.9	NO	-175.7	-98.5	N/A	-274.2	-208.2	NO	NO
Aberdeen Proving	MD	392825	0760655	54.9	5051.6	NO	-181.9	-111.0	N/A	-292.9	-226.9	NO	NO
Fort Huachuca	AZ	313500	1102000	66.0	3042.2	NO	-177.5	-102.2	N/A	-279.7	-228.6	NO	NO
Fort Monmouth	NJ	401900	0740215	53.8	5165.2	NO	-182.1	-111.4	N/A	-293.5	-227.4	NO	NO
Picatinny Arsenal	NJ	405600	0743400	53.2	5130.4	NO	-182.0	-111.3	N/A	-293.3	-227.3	NO	NO

Table 8 Land-Based Radar Test and Training Sites (Continued)

Radar Location		Lat (N)	Lon (w)	Bearing (deg.)	Distance (mi)	Profile (Is path under 250 miles?)	FSL (dB)	Estimated OH-Loss (dB)	Profiled OH-Loss (dB)	Total Path Loss (dB)	Interfering Power Level (dBW/MHz)	In-Band Interference?	Out-of Band Overload?
Redstone Arsenal	AL	343630	0863610	61.4	4464.9	NO	-180.8	-108.8	N/A	-289.7	-223.6	NO	NO
White Sands	NM	322246	1062813	64.9	3277.0	NO	-178.1	-103.5	N/A	-281.6	-230.6	NO	NO
Army Research	MD	390000	0765800	55.5	5005.6	NO	-181.8	-110.8	N/A	-292.6	-226.6	NO	NO
Fort Hunter	CA	355756	1211404	56.9	2455.1	NO	-175.6	-98.5	N/A	-274.1	-223.1	NO	NO
Kelly Support	PA	402357	0800925	54.2	4813.8	NO	-181.5	-110.2	N/A	-291.6	-225.6	NO	NO

Table Headings

Radar Location	:	The site name of the radar system
Lat (N)	:	Radar latitude
Lon (w)	:	Radar Longitude
Bearing (deg.)	:	Azimuth from earth station toward radar.
Distance (mi)	:	Distance from earth station to radar
Profile (Is path under 250 miles?)	:	If path is over 250 miles no OH-loss profile is generated
FSL (dB)	:	Free Space Loss
Estimated OH-Loss (dB)	:	Using a rounded-earth model an estimated OH-loss is calculated for long paths
Profiled OH-Loss (dB)	:	Using the NSMA Tropo Loss actual OH-loss calculcations are performed for shorter paths
Total Path Loss (dB)	:	Total of Free Space Loss plus Over-the-Horizon loss
Interfering Power Level (dBW/MHz)	:	Level of RF interference at the earth station's LNA input
In-Band Interference?	:	If the Radar is operating in-band is the max. permissible interference criteria being met?
Out-of Band Overload?	:	If the Radar is operating in out-of-band spectrum is the LNA overload threshold being met?

6.0 Conclusions

Calculations were performed to assess the electromagnetic compatibility (EMC) between the radars listed below and adjacent-band FSS earth station receiver at Kapolei, Hawaii. Interference assessment for Earth Stations Operating at 3625 - 3700 MHz at the Kapolei, Hawaii site identified 15 cases of In-band interference, and 6 of those cases also have Out-of Band Overload. The applicant is aware of this potential for interference and will work with the Government Users to mitigate the problem.

Results

Total Number of Paths 15 sites		Lat (N)	Lon (W)	Out-of-Band Overload?	In-Band Interference?
Pearl Harbor,	HI	212000	1580000	Yes	Yes
FORACS Hawaii1,	HI	212530	1581100	No	Yes
FORACS Hawaii2,	HI	212100	1581500	Yes	Yes
FORACS Hawaii3,	HI	211500	1580800	Yes	Yes
FORACS Hawaii4,	HI	211500	1580700	Yes	Yes
PMRF1	HI	220000	1594500	No	Yes
PMRF2	HI	220800	1620000	No	Yes
PMRF3	HI	224500	1614000	No	Yes
PMRF4,	HI	260000	1581500	No	Yes
PHS1	HI	190800	1591500	No	Yes
PHS2	HI	210000	1580800	Yes	Yes
PHS3	HI	210000	1573600	No	Yes
PHS4	HI	191800	1562000	No	Yes
PHS5	HI	184900	1574500	No	Yes
Ft. Shafter	HI	211800	1574900	Yes	Yes