Analysis of Non-Ionizing Radiation for a 11.0-Meter Earth Station System

This report analyzes the non-ionizing radiation levels for a 11.0-meter earth station system. The analysis and calculations performed in this report comply with the methods described in the FCC Office of Engineering and Technology Bulletin, No. 65 first published in 1985 and revised in 1997 in Edition 97-01. The radiation safety limits used in the analysis are in conformance with the FCC R&O 96-326. Bulletin No. 65 and the FCC R&O specifies that there are two separate tiers of exposure limits that are dependant on the situation in which the exposure takes place and/or the status of the individuals who are subject to the exposure. The Maximum Permissible Exposure (MPE) limits for persons in a General Population/Uncontrolled environment are shown in Table 1. The General Population/Uncontrolled MPE is a function of transmit frequency and is for an exposure period of thirty minutes or less. The MPE limits for persons in an Occupational/Controlled environment are shown in Table 2. The Occupational MPE is a function of transmit frequency and is for an exposure period of six minutes or less. The purpose of the analysis described in this report is to determine the power flux density levels of the earth station in the far-field, near-field, transition region, between the subreflector or feed and main reflector surface, at the main reflector surface, and between the antenna edge and the ground and to compare these levels to the specified MPEs.

Table 1. Limits for General Population/Uncontrolled Exposure (MPE)

Frequency Range (MHz)	Power Density (mW/cm^2)
30-300	0.2
300-1500	Frequency (MHz)*(0.8/1200)
1500-100,000	1.0

Table 2. Limits for Occupational/Controlled Exposure (MPE)

Frequency Range (MHz)	Power Density (mW/cm^2)
30-300	1.0
300-1500	Frequency (MHz)*(4.0/1200)
1500-100,000	5.0

Table 3. Formulas and Parameters Used for Determining Power Flux Densities

Parameter	Symbol	Formula	Value	Units
Antenna Diameter	D	Input	11.0	m
Antenna Surface Area	$A_{surface}$	$\pi D^2 / 4$	95.03	m^2
Subreflector Diameter	D_{sr}	Input	121.9	cm
Area of Subreflector	A_{sr}	$\pi D_{sr}{}^2/4$	11670.71	cm^2
Frequency	F	Input	5850	MHz
Wavelength	λ	300 / F	0.051282	m
Transmit Power	P	Input	76.00	W
Antenna Gain (dBi)	G_{es}	Input	55.4	dBi
Antenna Gain (factor)	G	$10^{Ges/10}$	346736.9	n/a
Pi	π	Constant	3.1415927	n/a
Antenna Efficiency	η	$G\lambda^2/(\pi^2D^2)$	0.76	n/a

1. Far Field Distance Calculation

The distance to the beginning of the far field can be determined from the following equation:

Distance to the Far Field Region

$$R_{ff} = 0.60\ D^2 / \lambda \quad (1)$$
$$= 1415.7\ m$$

The maximum main beam power density in the far field can be determined from the following equation:

On-Axis Power Density in the Far Field

$$S_{ff} = G\ P / (4\ \pi\ R_{ff}^{\ 2}) \quad (2)$$
$$= 1.046\ W/m^2$$
$$= 0.105\ mW/cm^2$$

2. Near Field Calculation

Power flux density is considered to be at a maximum value throughout the entire length of the defined Near Field region. The region is contained within a cylindrical volume having the same diameter as the antenna. Past the boundary of the Near Field region, the power density from the antenna decreases linearly with respect to increasing distance.

The distance to the end of the Near Field can be determined from the following equation:

Extent of the Near Field

$$R_{nf} = D^2 / (4\ \lambda) \quad (3)$$
$$= 589.9\ m$$

The maximum power density in the Near Field can be determined from the following equation:

Near Field Power Density

$$S_{nf} = 16.0\ \eta\ P / (\pi\ D^2) \quad (4)$$
$$= 2.443\ W/m^2$$
$$= 0.244\ mW/cm^2$$

3. Transition Region Calculation

The Transition region is located between the Near and Far Field regions. The power density begins to decrease linearly with increasing distance in the Transition region. While the power density decreases inversely with distance in the Transition region, the power density decreases inversely with the square of the distance in the Far Field region. The maximum power density in the Transition region will not exceed that calculated for the Near Field region. The power density calculated in Section 1 is the highest power density the antenna can produce in any of the regions away from the antenna. The power density at a distance R_t can be determined from the following equation:

Transition Region Power Density

$$S_t = S_{nf}\ R_{nf} / R_t \quad (5)$$
$$= 0.244\ mW/cm^2$$

4. Region between the Main Reflector and the Subreflector

Transmissions from the feed assembly are directed toward the subreflector surface, and are reflected back toward the main reflector. The most common feed assemblies are waveguide flanges, horns or subreflectors. The energy between the subreflector and the reflector surfaces can be calculated by determining the power density at the subreflector surface. This can be determined from the following equation:

Power Density at the Subreflector

$$S_{sr} = 4000\ P / A_{sr} \quad (6)$$
$$= 26.048\ mW/cm^2$$

5. Main Reflector Region

The power density in the main reflector is determined in the same manner as the power density at the subreflector. The area is now the area of the main reflector aperture and can be determined from the following equation:

Power Density at the Main Reflector Surface

$$S_{surface} = 4\ P / A_{surface} \quad (7)$$
$$= 3.199\ W/m^2$$
$$= 0.320\ mW/cm^2$$

6. Region between the Main Reflector and the Ground

Assuming uniform illumination of the reflector surface, the power density between the antenna and the ground can be determined from the following equation:

Power Density between Reflector and Ground

$$S_g = P / A_{surface} \quad (8)$$
$$= 0.800\ W/m^2$$
$$= 0.080\ mW/cm^2$$

7. Summary of Calculations

Table 4. Summary of Expected Radiation levels for Uncontrolled Environment

Region		Calculated Maximum Radiation Power Density Level (mW/cm^2)	Hazard Assessment
1. Far Field (R_{ff} = 1415.7 m)	S_{ff}	0.105	Satisfies FCC MPE
2. Near Field (R_{nf} = 589.9 m)	S_{nf}	0.244	Satisfies FCC MPE
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	0.244	Satisfies FCC MPE
4. Between Main Reflector and Subreflector	S_{sr}	26.048	Potential Hazard
5. Main Reflector	$S_{surface}$	0.320	Satisfies FCC MPE
6. Between Main Reflector and Ground	S_g	0.080	Satisfies FCC MPE

Table 5. Summary of Expected Radiation levels for Controlled Environment

Region		Calculated Maximum Radiation Power Density Level (mW/cm^2)	Hazard Assessment
1. Far Field (R_{ff} = 1415.7 m)	S_{ff}	0.105	Satisfies FCC MPE
2. Near Field (R_{nf} = 589.9 m)	S_{nf}	0.244	Satisfies FCC MPE
3. Transition Region ($R_{nf} < R_t < R_{ff}$)	S_t	0.244	Satisfies FCC MPE
4. Between Main Reflector and Subreflector	S_{sr}	26.048	Potential Hazard
5. Main Reflector	$S_{surface}$	0.320	Satisfies FCC MPE
6. Between Main Reflector and Ground	S_g	0.080	Satisfies FCC MPE

It is the applicant's responsibility to ensure that the public and operational personnel are not exposed to harmful levels of radiation.

8. Conclusions

Based on the above analysis it is concluded that harmful levels of radiation will not exist in regions normally occupied by the public or the earth station's operating personnel. The transmitter will be turned off during antenna maintenance so that the FCC MPE of 5.0 mW/cm2 will be complied with for those regions with close proximity to the reflector that exceed acceptable levels.

FREQUENCY COORDINATION AND INTERFERENCE ANALYSIS REPORT

Prepared for
Allen Holdings, Inc
MARCH AFB, CA
Satellite Earth Station

Prepared By:
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147
July 15, 2011

TABLE OF CONTENTS

1. CONCLUSIONS

An interference study considering all existing, proposed and prior coordinated microwave facilities within the coordination contours of the proposed earth station demonstrates that this site will operate satisfactorily with the common carrier microwave environment. Further, there will be no restrictions of its operation due to interference considerations.

2. SUMMARY OF RESULTS

There was no great circle interference cases were identified during the interference study of the proposed earth station.

No carriers reported potential interference cases.

3. SUPPLEMENTAL SHOWING

Pursuant to Part 25.203(c) of the FCC Rules and Regulations, the satellite earth station proposed in this application was coordinated by Comsearch using computer techniques and in accordance with Part 25 of the FCC Rules and Regulations.An information only coordination data for this earth station was sent to the below listed carriers with a letter dated 07/15/2011.

Company
ANAHEIM CITY, COMMUNICATIONS DIVISION
AT&T California
AirSites2000, LLC
BNSF Railway Company
CNG Communications, Inc.
COAST COMMUNITY COLLEGE DISTRICT
California, State of
Cellco Partnership - California
Coachella Valley Water District
Cox Communications - San Diego Mkt
FALCON CABLEVISION, A CALIFORNIA L.P.
KTLA INC
LOS ANGELES CITY WATER & POWER
LOS ANGELES UNIFIED SCHOOL DISTRICT
Los Angeles City Info Technology Agency
Los Angeles County Dept of Public Works
Los Angeles County FCC Licensing Section
Los Angeles SMSA Ltd. Partnership
METROPOLITAN AREA NETWORKS, INC.
MONTEBELLO CITY CALIFORNIA
Metropolitan Water Dist of So California
NEXTEL OF CALIFORNIA INC
New Cingular Wireless PCS - Los Angeles
New Cingular Wireless PCS LLC -San Diego
Nextweb Inc
ORANGE, COUNTY OF, CA
QUALCOMM INC.
Regional 3Cs
Riverside, County of
SAN DIEGO COUNTY
SAN DIEGO, CITY OF
SKYRIVER COMMUNICATIONS INC
SOUTHERN CALIFORNIA REGIONAL RAIL AUTH.
San Bernardino County of California
San Diego Gas & Electric Company
Southern California Edison Company
Southern California Gas Company
T-Mobile License LLC
TV MICROWAVES CO
Turn Wireless, LLC
University of California,HPWREN
Verizon California Inc.
Verizon Wireless (VAW) LLC (CA)
Western Pacific Mobile Microwave
Western Technical Services

4. EARTH STATION COORDINATION DATA

This section presents the data pertinent to frequency coordination of the proposed earth station that was circulated to all carriers within its coordination contours.

COMSEARCH

Earth Station Data Sheet

19700 Janelia Farm Boulevard, Ashburn, VA 20147
(703)726-5500 http://www.comsearch.com

Date: 07/15/2011
Job Number: 110715COMSTC11

Administrative Information

Call Sign	E000232
Licensee Name	Allen Holdings, Inc

Site Information — MARCH AFB, CA

Venue Name	
Latitude (NAD 83)	33° 54' 21.7" N
Longitude (NAD 83)	117° 14' 57.8" W
Climate Zone	A
Rain Zone	4
Ground Elevation (AMSL)	468.5 m / 1537.1 ft

Link Information

Satellite Type	Geostationary
Mode	TO - Transmit-Only
Modulation	Digital
Satellite Arc	177° W to 177° West Longitude
Azimuth Range	252.0° to 252.0°
Corresponding Elevation Angles	16.4° / 16.4°
Antenna Centerline (AGL)	5.49 m / 18.0 ft

Antenna Information — Transmit - V61103

Manufacturer	VERTEX COMMUNICATIONS
Model	11 KPC
Gain / Diameter	55.4 dBi / 11.0 m
3-dB / 15-dB Beamwidth	0.30° / 0.60°

		1M23G7W	9M00G7W
Max Available RF Power	(dBW/4 kHz)	-14.7	-14.7
	(dBW/MHz)	9.3	9.3
Maximum EIRP	(dBW/4 kHz)	40.7	40.7
	(dBW/MHz)	64.7	64.7
	(dBW)	65.6	74.22

Interference Objectives:	Long Term	-154.0 dBW/4 kHz	20%
	Short Term	-131.0 dBW/4 kHz	0.0025%

Frequency Information — Transmit 6.1 GHz

Emission / Frequency Range (MHz): 1M23G7W - 9M00G7W / 5850.0 - 5925.0

Max Great Circle Coordination Distance	137.8 km / 85.6 mi
Precipitation Scatter Contour Radius	100.0 km / 62.1 mi

COMSEARCH

Earth Station Data Sheet

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Coordination Values	**MARCH AFB, CA**
Licensee Name	Allen Holdings, Inc
Latitude (NAD 83)	33° 54' 21.7" N
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Ground Elevation (AMSL)	468.5 m / 1537.1 ft
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Antenna Model	VERTEX COMMUNICATIONS 11 KPC
Antenna Mode	Transmit 6.1 GHz
Interference Objectives: Long Term	-154.0 dBW/4 kHz 20%
Short Term	-131.0 dBW/4 kHz 0.0025%
Max Available RF Power	-14.7 (dBW/4 kHz)

Transmit 6.1 GHz

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)
0	0.85	107.34	-9.60	100.00
5	1.82	112.24	-10.95	100.00
10	0.93	116.93	-12.60	100.00
15	1.14	121.72	-12.60	100.00
20	2.69	126.76	-12.60	100.00
25	3.05	131.60	-12.60	100.00
30	2.37	136.16	-12.60	100.00
35	1.92	140.68	-12.60	100.00
40	1.90	145.22	-12.60	100.00
45	1.48	149.46	-12.60	100.00
50	0.88	153.33	-12.60	100.00
55	0.62	157.00	-12.60	100.00
60	0.54	160.24	-12.60	100.00
65	0.80	162.97	-12.60	100.00
70	0.92	164.43	-12.60	100.00
75	0.54	163.89	-12.60	100.00
80	0.00	161.82	-12.60	124.08
85	0.00	159.19	-12.60	124.08
90	0.00	155.84	-12.60	124.08
95	0.50	152.28	-12.60	100.19
100	0.78	148.24	-12.60	100.00
105	0.62	143.80	-12.60	100.00
110	1.07	139.45	-12.60	100.00
115	1.87	135.06	-12.60	100.00
120	2.38	130.47	-12.60	100.00
125	2.52	125.73	-12.60	100.00
130	1.78	120.83	-12.60	100.00
135	0.78	115.91	-12.60	100.00
140	0.00	111.04	-10.23	130.36
145	0.00	106.27	-9.60	132.04
150	0.00	101.49	-9.60	132.04
155	0.00	96.69	-9.60	132.04
160	0.00	91.90	-10.22	130.38
165	0.00	87.10	-10.60	129.36
170	0.00	82.30	-11.14	127.93
175	0.00	77.51	-12.10	125.40
180	0.00	72.73	-12.60	124.08
185	0.00	67.96	-12.60	124.08

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Antenna Model	VERTEX COMMUNICATIONS 11 KPC
Antenna Mode	Transmit 6.1 GHz
Interference Objectives: Long Term	-154.0 dBW/4 kHz 20%
Short Term	-131.0 dBW/4 kHz 0.0025%
Max Available RF Power	-14.7 (dBW/4 kHz)

Transmit 6.1 GHz

Azimuth (°)	Horizon Elevation (°)	Antenna Discrimination (°)	Horizon Gain (dBi)	Coordination Distance (km)
190	0.00	63.21	-12.60	124.08
195	0.27	58.43	-12.60	118.56
200	0.55	53.66	-12.06	100.00
205	0.48	48.99	-10.20	107.82
210	0.43	44.37	-8.47	116.33
215	0.55	39.77	-7.51	111.10
220	0.56	35.30	-5.72	115.65
225	0.54	30.98	-4.80	119.12
230	0.49	26.88	-3.35	125.32
235	0.51	23.08	-1.45	129.93
240	0.54	19.76	0.54	133.13
245	0.59	17.22	2.07	135.06
250	0.65	15.84	2.90	134.75
255	0.74	15.91	2.85	131.65
260	0.78	17.49	1.91	127.04
265	0.72	20.26	0.25	125.07
270	0.72	23.70	-1.82	118.99
275	0.53	27.70	-3.68	122.61
280	0.32	31.97	-4.99	133.63
285	0.23	36.35	-6.14	137.80
290	0.00	40.90	-7.78	135.75
295	0.00	45.46	-8.78	134.24
300	0.00	50.08	-10.63	129.28
305	0.20	54.71	-12.48	124.23
310	0.00	59.46	-12.60	124.08
315	0.00	64.20	-12.60	124.08
320	0.22	68.93	-12.60	122.28
325	0.61	73.68	-12.60	100.00
330	2.95	78.35	-11.93	100.00
335	3.92	83.19	-10.96	100.00
340	2.72	88.08	-10.60	100.00
345	1.57	92.92	-10.02	100.00
350	0.62	97.72	-9.60	102.57
355	0.57	102.52	-9.60	104.82

5. CERTIFICATION

I HEREBY CERTIFY THAT I AM THE TECHNICALLY QUALIFIED PERSON RESPONSIBLE FOR THE PREPARATION OF THE FREQUENCY COORDINATION DATA CONTAINED IN THIS APPLICATION, THAT I AM FAMILIAR WITH PARTS 101 AND 25 OF THE FCC RULES AND REGULATIONS, THAT I HAVE EITHER PREPARED OR REVIEWED THE FREQUENCY COORDINATION DATA SUBMITTED WITH THIS APPLICATION, AND THAT IT IS COMPLETE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

Timothy O. Crutcher
Frequency Planner
COMSEARCH
19700 Janelia Farm Boulevard
Ashburn, VA 20147

DATED: July 15, 2011