Andrew H. Thatcher
Environmental Health Physics

Evaluation of Compliance with FCC Guidelines for Human Exposure to Radiofrequency Radiation

Site Address:
425 Pontius Ave N.
Seattle WA 98109

Prepared for:

AT&T

August 15, 2013

Prepared By:

Andrew H. Thatcher, MSHP, CHP

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Introduction

This evaluation was prepared to determine the expected level of Non-Ionizing Electromagnetic Radiation (NIER) created by the proposed AT&T rooftop emitters at 425 Pontius Ave N., Seattle WA 98109. The evaluation includes the exposures from the existing T-Mobile antennas on the rooftop at the same address.

Executive Summary

The calculations for FCC general population exposure limits were calculated assuming that both T-Mobile and the proposed AT&T antennas were operating at 100% power. In the case of the proposed AT&T antennas this included an additional 4 transceivers per sector more than what is currently planned by AT&T. As the building upon which the antennas will be housed is in a dense urban environment, a number of additional evaluations were performed to ensure FCC compliance in all possible exposure scenarios. A total of four separate locations were evaluated which included ground level exposures, adjacent rooftops, in building exposures, and the rooftop of the building housing the antennas. The results of the evaluations are as follows:

- Maximum ground level exposures from the combined AT&T and T-Mobile antennas are less than 6 μW/cm² or approximately 1% of the FCC general population exposure limits.
- Maximum Permissible Exposures (MPE) on adjacent buildings is calculated as 450 μW/cm² or approximately 76% of the Federal Communications Commission (FCC) general population exposure limits. Actual exposures would be a fraction of the maximum predicted exposure.
- Maximum permissible in building exposures are calculated to be less than 30 μW/cm² or approximately 3% of the FCC general population exposure limits.
- At no location on the roof of 425 Pontius Ave N. does the radiofrequency exposure exceed the FCC Occupational MPE Limits. Maximum permissible exposures on the rooftop are predicted to exceed the FCC general population exposure limits when in close proximity to the AT&T radiating antennas. The following actions should be taken for the rooftop of the building:
    1. Access to the roof should be locked with restricted access and not accessible to the public or to workers that are not part of an RF safety program.
    2. Each sector should display a blue placarded NOTICE sign warning of the potential to exceed the FCC General Population Exposure Limits and an AT&T NOTICE TO WORKERS sign.

This NIER report indicates that the site will be in full compliance with the FCC general population exposure limits if access to the roof is restricted and notices are placed near the antenna shrouds as planned.

Exposure Evaluation

In 1996, the FCC adopted MPE limits for electric and magnetic field strength and power flux density for transmitters operating at frequencies used by wireless communication. These limits are based on recommendations made by the National Council on Radiation Protection and

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Measurements (NCRP) in 1986 and the ANSI/IEEE 1992 guidelines. The limits in Table 1 are for public exposures from the frequencies of interest. Appendix 1 details the FCC limits for Maximum Permissible Exposure for both occupational and public exposures.

Table 1. RF Exposure Limits for Microwave Frequencies

Frequency (MHz)	General Public Exposure Limits Power Density (μW/cm²)[1] (S) (Averaging Time = 30 min.)
Cellular (698 to 894 MHz)	465 to 596 (frequency/1500)
PCS and above (1500 to 100,000)	1,000

The FCC recommended guidelines for occupational exposure are a factor of 10 less than the lowest statistically significant levels where observed effects occurred. The public limits in Table 1 are an additional factor of five less than the occupational limits to account for the possibility of continuous exposures and the increased sensitivity of children and the elderly. The public limit is therefore a factor of 50 less than the lowest observed level where thermal effects are observed.

Equation 6 of OET Bulletin 65[2] is used as the basis for the calculations as it considers a truly worst case prediction of power density in an outdoor environment in which 100% of incoming radiation is assumed to reflect off a ground surface, resulting in a doubling of the predicted field strength and a four fold increase in power density. Indoor calculations would be lower than the outdoor calculations as complete ground reflection would not be included and a factor of ten reduction in signal strength due to attenuation through building materials is also considered. The formula is as follows:

$$S = [EIRP] / [\pi \bullet D^2]$$

WHERE:
S = Power density (mW/cm²)
EIRP = Effective isotropic radiated power (mW)
D = Hypotenuse distance (cm)

Table 2 shows the input parameters for the AT&T Alpha (50°) sector antennas. While the transmitter count shows only two active transmitters the compliance calculations assumed all antennas shown were operating at maximum power. The AT&T Beta sector (190°) antennas used the same configuration as the Alpha sector with slightly different electronic antenna downtilts. The AT&T Gamma (280°) antennas use 909 Watts Effective Radiated Power (ERP) for the UMTS 850 MHz bandwidth and 716 Watts for the UMTS 1900 MHz bandwidth while the ERP

[1] μW=microwatt. A microwatt is 1 *millionth* of a watt. So as a comparison, the electrical energy consumed by a common 40 watt lightbulb is 40,000,000 microwatts. cm^2 means per square centimeter. A centimeter = approximately 0.4 inch. So an exposure of "x" $\mu W/cm^2$ means the amount of RF energy, expressed as microwatts, reaching each square centimeter of a given surface, in this case, a human body.

[2] Federal Communications Commission Office of Engineering and Technology. Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields. OET Bulletin 65. 1997.

for the LTE bandwidths remained the same as the other two sectors. Appendix 2 shows the specifications for the AT&T KMW antennas as well as the T-Mobile Andrew antenna.

Table 2: Alpha Sector Planned Configuration for AT&T

Planned Configuration	Alpha					
	UMTS 850	UMTS 1900 (Off)	UMTS 850_1(Off)	UMTS 1900_1(Off)	LTE 700	LTE 1900 (Off)
Number of Antennas	1				1	
Antenna Port Number	7c+7d	7a+7b	7c+7d	7a+7b	10a+10b	10c+10d+10e+10f
Antenna Vendor	KMW				KMW	
Antenna Model	AM-X-CD-17-65-00T-RET				ET-X-UW-70-15-70-18-iR-AT	
Antenna (Band / Pol)	DBDP				DBDP	
Antenna HBW	63				70	
Azimuth	50				50	
Electrical Tilt	2	0	2	0	3	0
Mechanical Tilt	0				0	
RET	Yes	Yes	Yes	Yes	Yes	Yes
Antenna Dimensions (inches) (H,W,D)	96x11.8x5.9	96x11.8x5.9	96x11.8x5.9	96x11.8x5.9	72x14.8x5.9	72x14.8x5.9
Antenna Weight (lbs)	59.5	59.5	59.5	59.5	50	50
Rad Center (ft)	61	61	61	61	61	61
Number of Feeders	2				0	0
Feeder Type	Comm 1-5/8_850				Fiber	Fiber
Feeder Length	10				0	0
Jumper Type	FSJ4	FSJ4	FSJ4	FSJ4	FSJ4	FSJ4
Number of TMA	1				0	0
TMA Type	KUNAPA1100010				None	None
TMA DIM (Weight(lb),length,height)	-				-	-
Diplexed	Yes - U8 U8_1 U9 U9_1				No	No
Antenna (Sharing / Type)	No	No	No	No	No	No
MCPA	No	No	No	No	No	No
BCF Name	WASAU1239	WASAU1239	WASAU1239	WASAU1239		
Sector Name	WASAU1239X	WASAU1239A	WASAU1239T	WASAU1239D		
BSC/RNC	TACNWADNCRAR01	TACNWADNCRAR01	TACNWADNCRAR01	TACNWADNCRAR01		
CellID	12391	12397	42391	12394		
LAC	42989	42989	42989	42989		
TRX Count	1	0	0	0	1	0
ERP (dBm / Watts)	60.79 [dBm] / 1199 [W]	60.55 [dBm] / 1135 [W]	60.79 [dBm] / 1199 [W]	60.55 [dBm] / 1135 [W]	56.15 [dBm] / 412 [W]	59.55 [dBm] / 901 [W]

Table 3 shows the emitter information for the existing T-Mobile Antennas. The centerline of the antennas are mounted on a penthouse located 25 feet above the roof. The central location of the antennas on the penthouse creates a shadow shield such that the roof parapet will shield all exposures close in to the building less than ~120 feet.

Table 3: T-Mobile Antenna Information for Andrews TMBXX-6516-R2M					
Gain of 17.5 dBi	**Transmit**	**Receive**	**Sector 1 90 degrees**	**Sector 2 210 degrees**	**Sector 3 330 degrees**
GSM transceivers	TX: From 1970 MHz To 1975 MHz and 1980 MHz To 1985	RX: From 1890 MHz To 1895 MHz and 1900 MHz To 1905 MHz	**2@ 15 W each**	**3@ 10 W each**	**3@ 10 W each**
UMTS 1900 carriers	TX: From 1965 MHz To 1970 MHz	RX: From 1885 MHz To1890 MHz	**1@ 30 W**	**1@ 30 W**	**1@ 30 W**
UMTS 2100 carriers	TX: From 2130 MHz To 2135 MHz and 2145 MHz To 2155 MHz	RX: From 1730 MHz To 1735 MHz and 1745 MHz To 1755 MHz	**2@ 40 W**	**2@ 40 W**	**2@ 40 W**
LTE carrier	TX: From 2135 MHz To 2145 MHz	RX: From 1735 MHz To1745 MHz	**1@ 20 W**	**1@ 20 W**	**1@ 20 W**
		Total ERP per Sector	**5483 Watts**	**5483 Watts**	**5483 Watts**

Ground Level Exposures

Table 4 displays the calculational results for the maximum permissible exposure at 6' above ground level at ~480' from the base of the building for the Beta Sector assuming all antennas operating at 100%. The exposure results in a predicted maximum exposure of 5.8 µW/cm² or ~1% of the combined FCC general public exposure limit. All other ground level locations were less than this peak calculated exposure. The relative field factor represents the loss of transmit power for any angles other than the direct path of the radiating antennas.

Table 4: Radiofrequency Exposure Analysis Summary

Site Name:	S. Lake Union							
Location	Beta Sector	425 Pontius Ave N. Seattle WA 98109						
Carrier Type	Worst Case ERP (watts)	Worst Case ERP (dB)	Antenna Height (ft)	Horizontal Distance to Maximum Exposure (ft)	Relative Field Factor (numeric)	Maximum outdoor exposure (with ground reflection) (µW/cm²)	% of Standard	General Population Exposure Limit (µW/cm²)
T-Mobile UMTS	5482	67.39	82	120	0.0048	6.26E-02	0.01%	1,000
AT&T UMTS 850	2398	63.80	65.9	120	7.94E-01	4.44E+00	0.78%	566
AT&T UMTS 1900	2270	63.56	65.9	120	6.17E-02	3.26E-01	0.03%	1000
AT&T LTE 700	412	56.15	65.9	120	3.09E-03	9.18E-01	0.19%	480
AT&T LTE 1900	901	59.55	65.9	120	7.24E-03	2.01E-02	0.00%	1000
					Total	**5.77E+00**	**1.02%**	

Radiofrequency Exposures on Nearby Rooftop

There are numerous buildings surrounding 425 Pontius Ave. N. There are no AT&T antennas pointing in the direction of the building due north. Figure 1 shows an overhead Google Maps view of the building and surrounding structures. Of interest is the apartment building located due west of the proposed AT&T Gamma sector (280°) antennas. Google maps shows the distance from the Gamma sector antennas to the closest rooftop location is approximately 39 feet. The adjacent building is 6' lower than 425 Pontius Ave N. and the centerline of the Gamma sector antennas is 65.75'. After subtracting the 6 foot height of the head of an adult the vertical differential is approximately 6'. The current plans call for only a single UMTS 850 MHz transceiver and a single LTE 700 transceiver. Calculations were performed for all six transceivers. Table 5 shows the calculated MPE on the adjacent rooftop to be 447 µW/cm² or just over 75% of the combined FCC general population exposure limit. No restrictions would be required for this roof or the roof just south of this location. This MPE exposure estimate is very conservative as it assumes a complete ground reflection of the signal which is not likely given the vegetated nature of the adjacent roof surface which would alone result in a factor of four reduction in the power density. Actual exposures assuming only two transceivers under nominal power loading and limited ground reflection would likely be about 10 µW/cm².

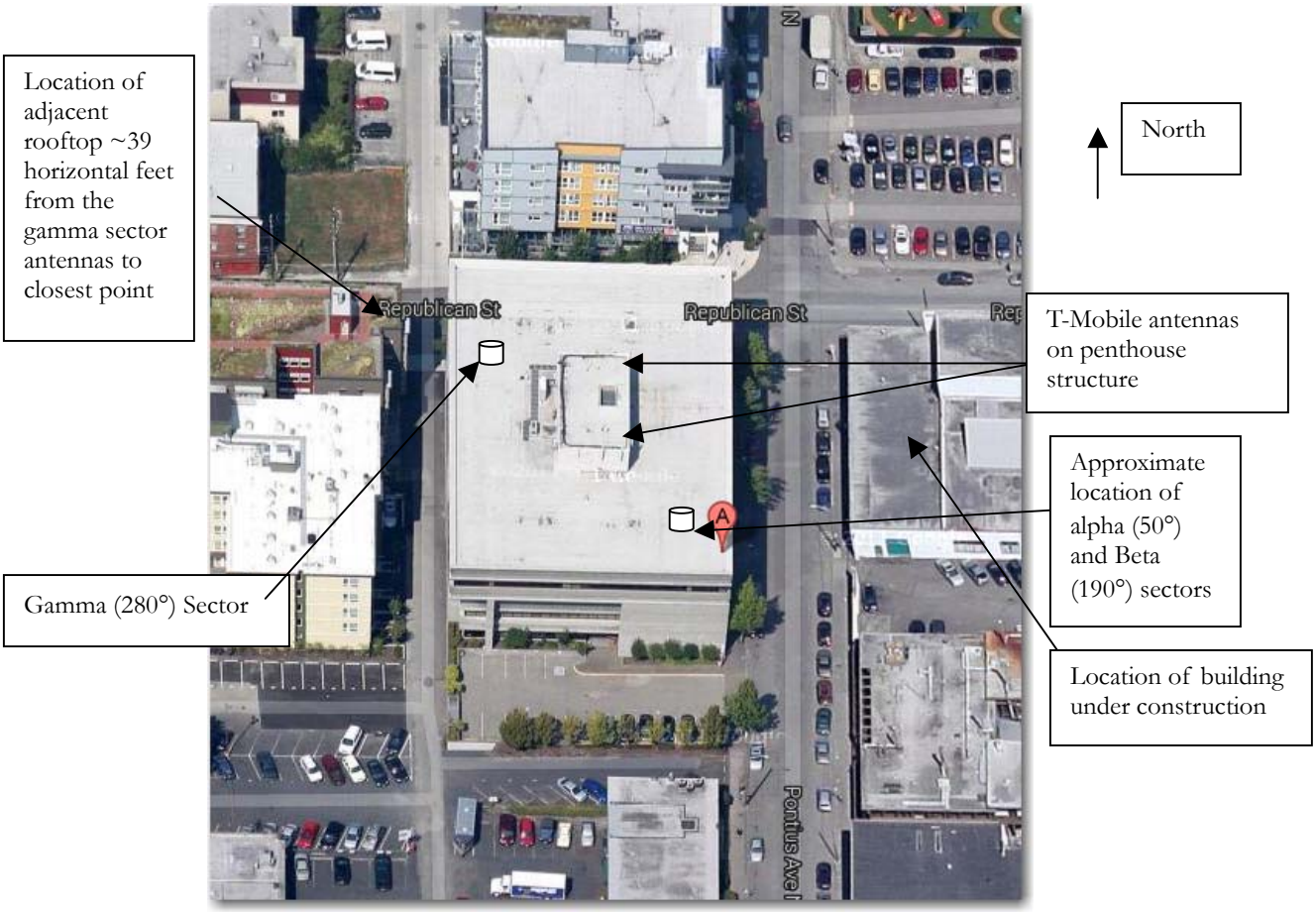

Figure 1: Google Map view of the Building

Table 5: Maximum Exposure on Adjacent Rooftop								
Site Name:	S. Lake Union							
Location	Gamma Sect	425 Pontius Ave N. Seattle WA 98109						
Carrier Type	Worst Case ERP (watts)	Worst Case ERP (dB)	Relative Antenna Height (ft)	Horizontal Distance to Maximum Exposure (ft)	Relative Field Factor (numeric)	Maximum outdoor exposure (with ground reflection) (μW/cm²)	% of Standard	General Population Exposure Limit (μW/cm²)
T-Mobile UMTS	5482	67.39	22	79	0.0851	1.36E-01	0.00%	1,000
AT&T UMTS 850	1818	62.60	6	39	2.82E-01	1.96E+02	34.67%	566
AT&T UMTS 1900	1432	61.56	6	39	1.91E-02	1.05E+01	1.05%	1000
AT&T LTE 700	412	56.15	6	39	9.33E-01	1.47E+02	30.68%	480
AT&T LTE 1900	901	59.55	6	39	2.69E-01	9.29E+01	9.29%	1000
						4.47E+02	75.68%	

Table 6 provides an estimate of the rooftop exposure at the nearest point on the proposed building to the east. The horizontal distances are shown in Table 6 and the relative field factor shows a nominal reduction in power due to a small assumed difference in height. Again, assuming all transceivers for both carriers operating at full power the predicted ERP is 310 µW/cm² or 37% of the combined FCC general population exposure limit.

Table 6: Peak Location on Adjacent Rooftop								
Site Name:	S. Lake Union		425 Pontius Ave N. Seattle WA 98109					
Location	Alpha Sector (90 degrees for T-Mobile and 50 degrees for AT&T)							
Carrier Type	Worst Case ERP (watts)	Worst Case ERP (dB)	Relative Antenna Height (ft)	Horizontal Distance to Maximum Exposure (ft)	Relative Field Factor (numeric)	Maximum outdoor exposure (with ground reflection) (µW/cm²)	% of Standard	General Population Exposure Limit (µW/cm²)
T-Mobile UMTS	5482	67.39	28	100	6.31E-01	1.61E+02	16.14%	1,000
AT&T UMTS 850	2398	63.80	12	113	6.03E-01	5.28E+01	9.33%	566
AT&T UMTS 1900	2270	63.56	12	113	6.31E-01	5.23E+01	5.23%	1000
AT&T LTE 700	412	56.15	12	113	1.00E+00	1.51E+01	3.14%	480
AT&T LTE 1900	901	59.55	12	113	8.71E-01	2.87E+01	2.87%	1000
					Total	**3.10E+02**	**36.71%**	

In Building Exposures

Using the Alpha sector as the reference for calculations and the power levels shown in Table 4, an individual is assumed to stand on the upper floor under the alpha sector antennas but 5 feet in front or essentially near the eastern wall of the building. The vertical separation from the centerline of the antennas to the individual's head is assumed to be 12 feet. Table 7 displays the calculated results and assumes no ground reflection of a signal but neglects the 10 to 20 dB additional reduction in power density due to the shielding in the roof and walls. The analysis shows that the MPE for the upper floors of the building are less than 30 µW/cm² or about 3% of the FCC general public exposure limits. Actual exposures would be significantly less than these calculated values.

Table 7: Upper Floor Peak Exposure								
Site Name:	S. Lake Union		425 Pontius Ave N. Seattle WA 98109					
Location	Alpha Sector							
Carrier Type	Worst Case ERP (watts)	Worst Case ERP (dB)	Relative Antenna Height (ft)	Horizontal Distance to Maximum Exposure (ft)	Relative Field Factor (numeric)	Maximum outdoor exposure (with ground reflection) (µW/cm²)	% of Standard	General Population Exposure Limit (µW/cm²)
T-Mobile UMTS	5482	67.39	na	na	na	shielded	0.00%	1,000
AT&T UMTS 850	2398	63.80	12	5	9.12E-04	1.82E+00	0.32%	566
AT&T UMTS 1900	2270	63.56	12	5	1.38E-02	2.61E+01	2.61%	1000
AT&T LTE 700	412	56.15	12	5	2.00E-03	6.84E-01	0.14%	480
AT&T LTE 1900	901	59.55	12	5	3.16E-05	2.37E-02	0.00%	1000
					Total	**2.86E+01**	**3.07%**	

Rooftop Exposure

Rooftop exposures are typically in a mixture of both near and far field exposures and can be complicated to calculate. Richard Tell Associates[3] have developed a cylindrical model software program that can be used in evaluating RF fields near vertical collinear dipole antennas systems such as those used by AT&T and T-Mobile at this facility. The RoofView® program can predict both the near and far-field exposures and follows the guidance described in FCC Office of Engineering and Technology Bulletin 65. This program, RoofView®, was employed in this evaluation of the exposures from the antennas on this roof. In close in situations, the cylindrical model will be more accurate as the far-field model will significantly over-predict the RF power densities. The results for the Alpha and Beta sectors are shown in Figure 2. Note that the six transceivers assumed for each sector are significantly in excess of the single UMTS 850 and LTE 700 antennas currently planned for this sector. The areas in red represent exposure areas at 50% to 100% of the FCC general population exposure limit. Areas colored in blue are greater than the FCC general population exposure limit. All areas are less than the FCC occupational exposure limits. Due to the height of the T-Mobile antennas located on the penthouse structure of the roof, no significant exposure exists from their antennas. Even if only the two planned transceivers are used, a small area exists near each antenna that could exceed the FCC general population exposure limits. As such, the following steps should be taken for the roof:

1. Access to the roof should be locked with restricted access and not accessible to the public or to workers that are not part of an RF safety program.
2. Each sector should display a blue placarded NOTICE sign warning of the potential to exceed the FCC General Population Exposure Limits and an AT&T NOTICE TO WORKERS sign.

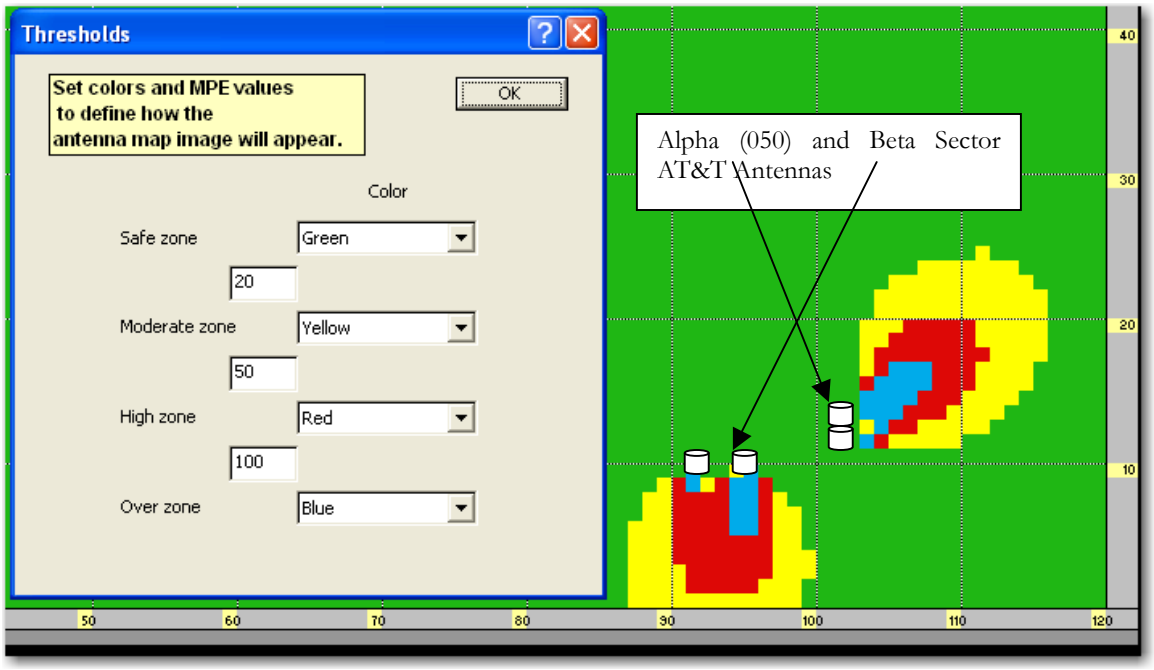

Figure 2: Alpha and Beta Sectors of roof on 425 Pontius Ave. N.

[3] Richard Tell Associates, RoofView and RoofView User Guide, version 4.15. January 2011.

Environmental Evaluation

According to Table 2 of Appendix A of Bulletin 65, a PCS facility is subject to routine environmental evaluation if the building mounted antennas total power exceeds 2,000 W ERP or the cellular service for a building mounted antenna exceeds 1,000 W ERP. The proposed facility exceeds the Table 2 values due to the UMTS 850 MHz transceiver. However, 47 CFR 1.1307 (b) requires preparation of an Environmental Assessment (EA) if the particular facility, operation or transmitter would cause human exposure level of radiofrequency radiation in excess of the FCC general public or occupational exposure limits. This analysis has shown that in no case will the general public have access to areas that exceed the FCC general public exposure limits. The completion of this NIER report fulfils the requirements for radiofrequency evaluation.

Conclusions

The calculations for FCC general population exposure limits were calculated assuming that both T-Mobile and the proposed AT&T antennas were operating at 100% power. In the case of the proposed AT&T antennas this included an additional 4 transceivers per sector more than what is currently planned by AT&T. As the building upon which the antennas will be housed is in a dense urban environment, a number of additional evaluations were performed to ensure FCC compliance in all possible exposure scenarios. A total of four separate locations were evaluated which included ground level exposures, adjacent rooftops, in building exposures, and the rooftop of the building housing the antennas. The results of the evaluations are as follows:

- Maximum ground level exposures from the combined AT&T and T-Mobile antennas are less than 6 μW/cm² or approximately 1% of the FCC general population exposure limits. Differences in elevation gain or loss from the building were not considered and could result in minor differences from those that are presented but would not change the overall conclusion of ground level exposures being well within the FCC general population exposure limits.
- Maximum permissible exposures on adjacent buildings is calculated as 450 μW/cm² or approximately 76% of the FCC general population exposure limits. Actual exposures would be a fraction of the maximum predicted exposure.
- Maximum permissible in building exposures are calculated to be less than 30 μW/cm² or approximately 3% of the FCC general population exposure limits.
- At no location on the roof of 425 Pontius Ave N. does the radiofrequency exposure exceed the FCC Occupational MPE Limits. Maximum permissible exposures on the rooftop are predicted to exceed the FCC general population exposure limits when in close proximity to the AT&T radiating antennas. The following actions should be taken for the rooftop of the building:
    3. Access to the roof should be locked with restricted access and not accessible to the public or to workers that are not part of an RF safety program.
    4. Each sector should display a blue placarded NOTICE sign warning of the potential to exceed the FCC General Population Exposure Limits and an AT&T NOTICE TO WORKERS sign.

This NIER report indicates that the site will be in full compliance with the FCC general population exposure limits if access to the roof is restricted and notices are placed near the antenna shrouds as planned.

Certification

I hereby certify the following:

1. I have read and fully understand the FCC regulations concerning RF safety and the control of human exposure to RF fields.
2. To the best of my knowledge, the statements and information disclosed in this report are true, complete and accurate.
3. The results of the analysis indicate that the site is in full compliance with the FCC regulations concerning RF exposure.

Qualifications

I am a board certified health physicist and public health professional with over 23 years experience in both ionizing and non ionizing evaluation of occupational and environmental exposures. My masters degree is in health physics, am a past panel chairman for certification of health physicists nationally, and am currently a Clinical Associate Professor of Health Physics at Vanderbilt University. My board certification expires in 2016.

Regards,

Andrew H. Thatcher, MSHP, CHP

Appendix 1

FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

NOTE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

Appendix 2
KMW Antenna Specifications

Simply Intelligent

KMW Communications
Base Station Antennas
For Mobile Communications

AM-X-CD-17-65-00T-RET(8' 65° Dual Broadband Antenna)

Dual Band Electrical DownTilt Antenna

698 ~ 894MHz, X-pol., H65° / V8.0°

1710 ~ 2170MHz, X-pol., H65° / V7.0°

Electrical Specification

Frequency Range		698~894MHz	1710~2170MHz
Impedance		50Ω	
Polarization		Dual, Slant ±45°	
Gain		16.8dBi / 14.65dBd @ 698-806MHz 17.5dBi / 15.35dBd @ 824-894MHz	17.0dBi / 14.85dBd @ 1710-1755MHz 17.3dBi / 15.15dBd @ 1850-1900MHz 17.5dBi / 15.35dBd @ 2110-2155MHz
Beamwidth	Horizontal	68° @ 698-806MHz 63° @ 824-894MHz	67° @ 1710-1755MHz 65° @ 1850-1900MHz 62° @ 2110-2155MHz
	Vertical	9.2° @ 698-806MHz 8.0° @ 824-894MHz	7.3° @ 1710-1755MHz 7.0° @ 1850-1900MHz 6.7° @ 2110-2155MHz
VSWR		≤1.5:1	
Front-to-Back Ratio		≥27 dB	
Electrical Downtilt Range		0° ~ 12°	0° ~ 10°
Isolation Between Ports		≥30 dB	
Isolation Between Ports of Different Frequency Elements		≥35 dB	
Cross Pole Discrimination		10.0 dB @ ±60° 15.0 dBi @ 0°	
First Upper Side Lobe Suppression		16dB	
Side Lobe Suppression		> 16 dB @ 0-6° Tilt > 18 dB @ 7-12° Tilt (Up to 10° from Boresight)	> 16 dB @ 0-6° Tilt > 18 dB @ 7-10° Tilt (Up to 10° from Boresight)
Passive Intermodulation		≤ -150 dBc @ 2x20w	
Input Maximum CW Power		500 W	300 W
Environmental Compliance		IP65 for Radome IP67 for Connectors	
RET Motor Configuration		Field Replaceable RET Electronic Control Module / RET Motor is internal to antenna & not field replaceable	
Compliant with AISG 1.1 and 2.0		AISG 1.1 and 2.0	

Mechanical Specification

Dimension (WXDXH)	11.8X6.0X96 inches
Weight (Without clamp)	59.5 lbs (27.0 kg)
Connector	4 x 7/16 DIN(F), Long Neck
Max Wind Speed	150 mph
Wind Load (@150 mph)	2521 N

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Appendix 2

KMW Antenna Specifications Continued..

Note: specs below are for a similar KMW antenna. Actual specifications for vertical antenna radiation pattern from manufacturer used[4]

Simply Intelligent

EDTA (Electrical Down Tilt Antenna)

Field Replacement Internal RET

790~960MHz, XXX-pol., H65° / V11°, ET2~16°
2 x (1710~2170MHz, XXX-pol., H65° / V7°, ET0~10°

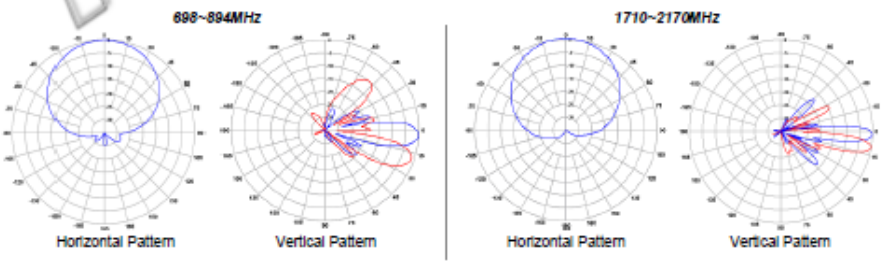
AISG

Electrical Specification

Product Number		ET-X-TG-65-18-65-17-IR			
Frequency Band		790~960MHz		2 x (1710~2170MHz)	
Frequency Range		790~894MHz	870~960MHz	1710~1990MHz	1920~2170MHz
3dB Beam-Width	Horizontal	66°	62°	67°	62°
	Vertical	11.0°	10.5°	7.0°	6.5°
Gain (dBi /dBd)		16.0 / 12.0	16.3 / 13.2	17.0 / 14.9	17.5 / 15.4
Electrical Down Tilt Range		2° ~ 16°		0° ~ 10°	
1st Upper Sidelobe Suppression		≥ 14dB		≥ 15dB	
Front-to-Back Ratio		≥ 25dB		≥ 30dB	
Polarization Type		Dual, Slant ±45°		Dual, Slant ±45°	
Cross –Polar Discrimination	Boresight	≥ 18dB		≥ 15dB	
	±60°	≥ 10dB		≥ 7dB	
Input Maximum CW Power		350W		250W	
Impedance		50Ω		50Ω	
VSWR (Return Loss)		≤1.5:1 (≥ 14dB)		≤1.5:1 (≥ 14dB)	
Isolation	Between Ports	≥ 27dB		≥ 27dB	
	Between Bands	≥ 35dB (790~960MHz / 1710~2170MHz)			
Passive Intermodulation, IM3		≤ -150dBc (@2x43dBm)			
Antenna Control Interface		Field Replaceable Internal RET, AISG1.1 or AISG2.0			

Mechanical Specification

Dimension (Length x Width x Depth)	1829mm x 460mm x 180mm (72.0" x 18.1" x 7.1")
Weight without Clamp	29.2kg (64.5lbs)
Max. Wind Speed	60m/s (135mph)
Wind Load (@100mph), Front / Side / Rear	1289.7N / 1289.7N / 1289.7N (289.5lbf / 289.5lbf / 289.5lbf)
Connector (Type / Position)	6 x 7/16" DIN(Female) / Bottom



Specifications are subject to change without notice. 20 Aug. 2010

KMW
RF & Microwave Products

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[4] Song, Brian. Air Interface Solutions Strategic Account Executive, KMW. Email RE: Vertical radiation pattern request. August 6, 2013

Appendix 2
Andrew Antenna Specifications

TMBXX-6516-R2M
±45° Diversity, Quad Antenna

Decibel®
Base Station Antennas

- Patented cross dipole and feed system
- Rugged, reliable design with excellent PIM suppression
- Includes factory installed AISG RET actuator
- Fully compatible with Andrew Teletilt® remote control antenna system

ELECTRICAL

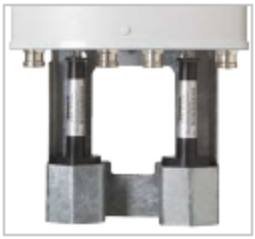
Frequency Range (MHz):	1710–2155
Characteristic Impedance (Ohms):	50
Azimuth BW (Deg):	64.5 ± 8
Elevation BW (Deg):	7.2 ± 1.2
Gain (dBi) :	17.5 ± 0.8
Polarization:	±45°
Front-to-Back Ratio (dB)	0° 2° 4° 6° 8° 10°
Copol, 180° ± 30°:	>24 >24 >24 >24 >24 >24
Total Power, 180° ± 30°:	>24 >24 >23 >22 >23 >23
Upper Sidelobe (dB)	0° 2° 4° 6° 8° 10°
Main Beam to +20°:	>18 >18 >17 >15 >14 >11
VSWR / Return Loss (dB):	1.35:1 / 16.5
Port-to-Port Isolation (dB):	>30
Electrical Tilt Range (Deg)*:	0–10
Electrical Downtilt Accuracy (Deg):	± 0.9
Cross-pol (dB)	0° 2° 4° 6° 8° 10°
3 dB Beamwidth:	>13 >13 >13 >12 >12 >12
Intermodulation Products (dBc)	
3rd Order, 2 x 20 Watts:	155
Max. Input Power (Watts):	250
Lightning Protection:	DC Ground

PERFORMANCE TRACKING

Gain Variation (dB) (between UL and DL frequency pair):	1.3
Electrical Tilt Accuracy (Deg) (between UL and DL frequncy pair within 0.5°):	<0.55
Azimuth HPBW (Deg) (between UL and DL frequncy pair):	11.5

MECHANICAL

Net Weight (kg / lbs):	15.7 / 34.6
Dimensions–LxWxD: (with actuator)	1499 x 302 x 160 mm 59 x 11.9 x 6.3 inch
Max. Wind Area (m² / ft²):	0.27 / 2.9
Max. Wind Load (N / lbf):	729.4 / 164
Max. Wind Speed (km/h / mph):	241 / 150
Hardware Material:	Hot Dip Galvanized
Connector Type:	7-16 DIN, Female (4)
Color:	Off White
Standard Mounting Hardware:	TM600899A-2



*Specifications may vary when using 0° or 1° electrical tilt.

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Appendix 3

Andrew Antenna Vertical Radiation Pattern