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

T-Mobile Small Cell Statement of Compliance Wellesley Hub NEH0021A

Wellesley MA 02481

Prepared for:

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Introduction

This report assesses levels of exposure to radiofrequency (RF) energy from a T-Mobile USA proposed small cell hub that consist of antennas operating in the 600 MHz, 700 MHz, 1900 MHz, 2100 MHz and 2.5 GHz bands of service. The combined antennas will be mounted ~36' centerline above grade. This report analyzes the cumulative RF exposures from the proposed small cells at ground level as well as specifies the safe approach distances at the height of the antennas for both occupational workers and members of the public.

Summary of Findings

The proposed Galtronics antennas are comprised of separate antennas for each frequency band mounted vertically within the cylindrical antenna. All small cell nodes within the hub have a common antenna height of 36' so the analysis for one node applies to all of the nodes.

Analysis shows that the cumulative emissions (from all antennas over all transmission bands) from the proposed T-Mobile transmitters will comply with FCC limits for human exposure to RF energy at any accessible locatoin. Maximum RF exposure levels at all ground level locations will be less than 3% of the FCC exposure limits for the general public.

Technical Data

A single equipment configuration is evaluated using the N600 MHz, L600 MHz, L700 MHz, 1900 MHz (PCS), 2100 MHz (AWS), and 2500 MHz (n41) bands.

Methodology

The theoretical modelling of the RF electromagnetic fields has been performed in accordance with the OET Bulletin 65 provided by the FCC. The Maximum Permissible Exposure (MPE) limits utilized in this analysis are outlined in Figure 1 and in Table 1 and Table 2.

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Figure 1:
FCC Limits for Maximum Permissible Exposure (MPE) Plane-wave Equivalent Power Density

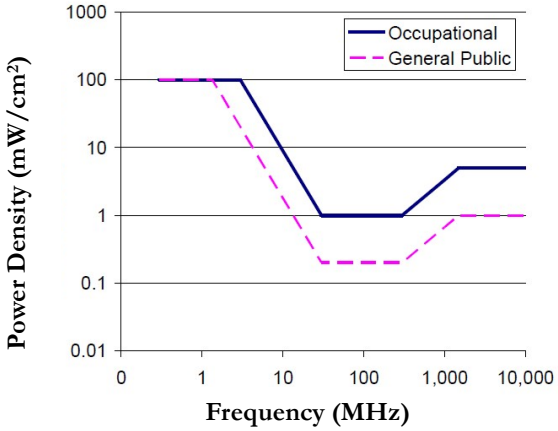


Table 1:
Limits for Occupational/Controlled Exposure (MPE)

Frequency Range (MHz)	Power Density (S) in (mW/cm^2)
0.3-3.0	(100)
3.0-30	($900/f^2$)
30-300	1.0
300-1500	f/300
1500- 100,000	5

f = frequency in MHz

Table 2:
Limits for General Population/Uncontrolled Exposure (MPE)

Frequency Range (MHz)	Power Density (S) in (mW/cm^2)
0.3-1.34	(100)
1.34-30	(180/f2)
30-300	0.2
300-1500	f/1500
1500- 100,000	1.0

f = frequency in MHz

The IXUS electromagnetic field (EMF) calculation software is used to assess all the RF field levels presented in this study. IXUS (https://ixusapp.com/) is a software product of Alphawave Mobile Network Products (Pty) Ltd, who specialize in electromagnetic software and systems.

The IXUS software uses a fast and accurate EMF calculation tool that allows for the determination of radio-frequency (RF) field strength in the vicinity of radio communication base stations (RBS) and transmitters. At its core, the IXUS EMF calculation module implements field evaluation techniques detailed in the ITU-T K.61, CENELEC 50383, and IEC62232 specifications. The calculation of EMF results at any point in 3-D space is achieved by either a synthetic ray tracing technique, a conservative cylindrical envelope method, or through full-wave EM simulation results obtained from a computational electromagnetic software tool, FEKO (https://www.altair.com/feko/). The selection of the solution method is determined by the particular antenna being considered. In addition, a conservative and verified modelling technique for 5G beamforming antennas in IXUS is also used. The simulation accuracy of the IXUS calculation module has been verified extensively with full-wave EM simulations using FEKO.

Furthermore, all antenna models that are used in the IXUS modeller undergoes a rigorous verification process, whereby manufacturer data obtained from datasheets or pattern information is compared to that of the IXUS antenna model, during the synthesis process.

For the field sampling for the overall ground level compliance a spatial averaging scheme was applied at 0.3 m increments in a vertical plane over the height of a theoretical human 6’ in height in accordance with the IEC62232 specifications.

Results

Figure 2 includes the calculated maximum cumulative spatially averaged RF exposure at 0’ to 6’ above ground for the assuming all antennas operating at 100% power and complete ground reflection. To determine the maximum cumulative exposure the total RF signal levels from each T-Mobile antenna was summed at each location as a percent of the FCC exposure limit (which varies somewhat with frequency). The maximum cumulative exposure at any accessible location was determined to be 2.01% of the FCC general public exposure limit. The compliance evaluation was performed at antenna heights from 33’ to 36’.

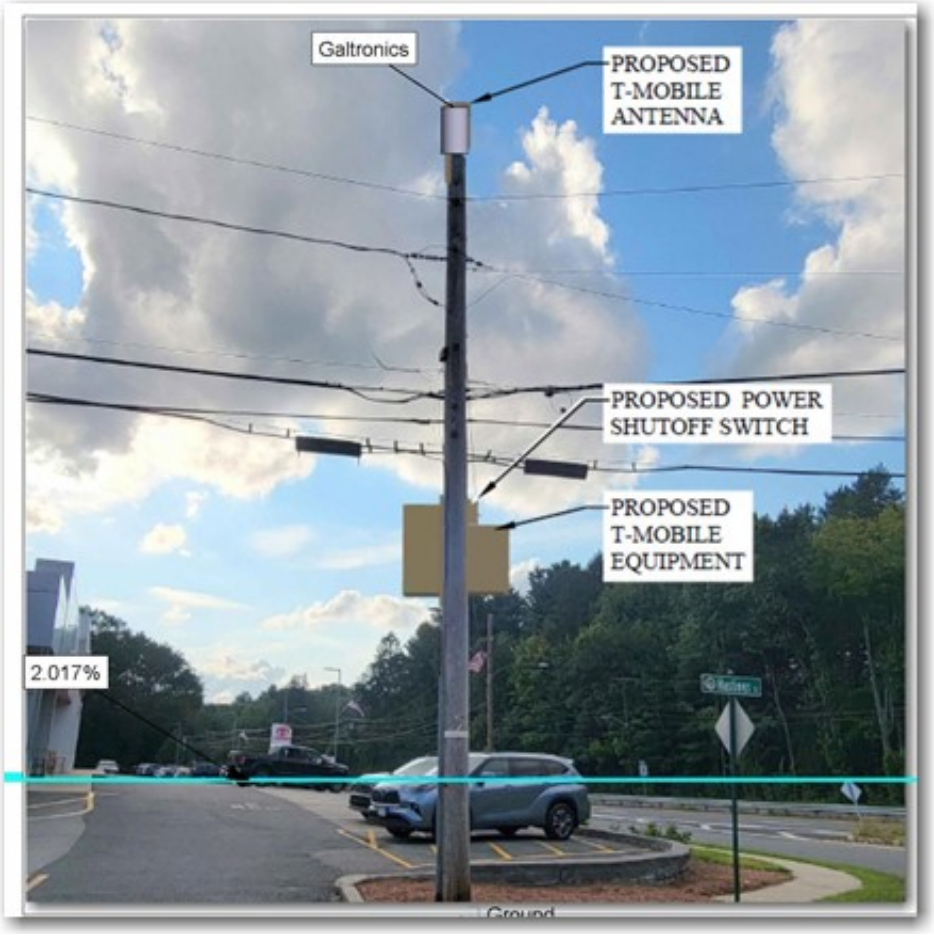


Figure 2: Exposure at ground level.

Antenna details are provided in Table 4. Additional details about the Galtronics antenna are found in Appendix A.

Table 4: Antenna Details					
Owner	Make/Model	Height (ft)	Azimuth	Frequency Band	Combined Power all transmitters (watts)
T-Mobile	Galtronics/GQ2408-07583	36	Omnidirectional	L650MHz	80
T-Mobile	Galtronics/GQ2408-07583	36	Omnidirectional	N650 MHz	80
T-Mobile	Galtronics/GQ2408-07583	36	Omnidirectional	LTE 700	80
T-Mobile	Galtronics/GQ2408-07583	36	Omnidirectional	2500 MHz	80
T-Mobile	Galtronics/GQ2408-07583	36	Omnidirectional	LTE 1900	80
T-Mobile	Galtronics/GQ2408-07583	36	Omnidirectional	LTE 2100	80

Conclusions/Recommendations

The proposed Galtronics antennas are comprised of separate internal antennas for each frequency band mounted vertically within the cylindrical antenna.

Analysis shows that the cumulative emissions (from all antennas over all transmission bands) from the proposed T-Mobile transmitters will comply with FCC limits for human exposure to RF energy at any place of public access. Maximum RF exposure levels at all ground level locations will be less than 3% of the FCC exposure limits for the general public.

Statement of Qualifications

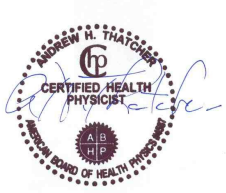
I am an IEEE member, an American Board of Health Physics certified health physicist and public health professional with over 30 years experience in evaluating both ionizing and non ionizing radiation exposures. My masters degree is in health physics, I was a panel chairman for certification of health physicists nationally, was the radiofrequency expert for the State of Washington for an 18 year period, am an editor of the Health Physics Journal for non ionizing radiation topics, am a consultant of the ACGIH Threshold Limit Values for Physical Agents Committee and was an Adjunct Professor of Health Physics at Vanderbilt University from 2004 to 2014. My current certification expires in 2024.

RF 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, based on engineering design data for the site supplied to me by T-Mobile USA.
3. The results of the analysis indicate that the site is in full compliance with the FCC regulations concerning RF exposure at all areas of public access.
4. Transmission equipment for the T-Mobile USA facility is certified by the FCC under the equipment authorization procedures set forth in the FCC rules. This assures that the wireless facility will transmit within assigned frequency bands, and at authorized power levels. The T-Mobile USA facility will operate in accordance with all FCC rules regarding power, signal bandwidth, interference mitigation, and good RF engineering practices. The T-Mobile USA facility will comply with all FCC standards for radio frequency emissions.

Regards,



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Appendix A

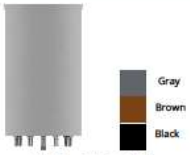
GALTRONICS
A Baylin Technologies Company

2' 8-Port Quasi-Omni Pattern Canister Antenna [617-746 and 1695-2690 MHz]

GQ2408-07583

Description:

- Quasi-Omni Pattern Canister Canister Antenna for Small Cells and Outdoor DAS
- 4x ports for Low Band 617-746 MHz
- 4x ports for AWS/PCS/WCS/BRS Band 1695-2690 MHz



617-746 and 1695-2690 MHz
8-Port Quasi-Omni Pattern Canister Antenna

Electrical Specifications

Frequency Band [MHz]	617-698	698-746	1695-2200	2305-2360	2496-2690
Input Connector Type	4x 4.3-10(F)		4x 4.3-10(F)		
Isolation (min.)	25 dB				
VSWR (max.) /RL (min.)	1.5:1 / 14.0 dB				
Impedance	50 Ω				
Polarization	Dual slant 45° (±45°)				
Horizontal Beamwidth	Omni (360°)				
Vertical Beamwidth	82°	74°	22.6°	18.8°	17.3°
Gain (max.)	3.3 dBi	3.8 dBi	9.0 dBi	9.1 dBi	9.1 dBi
Gain (avg.)	2.7 dBi	3.1 dBi	7.8 dBi	8.5 dBi	8.4 dBi
Downtilt	0° Fixed				
Max Power / Port	100 Watts				
PIM @ 2x43 dBm	<-153 dBc				

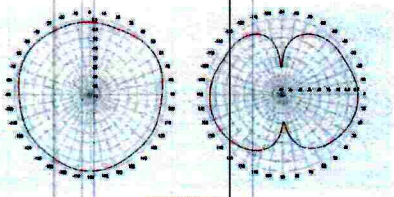
Mechanical Specifications

Operating Temperature	-40° to 158°F (-40° to +70°C)
Antenna Weight	21.0 lbs (9.5 kg)
Antenna Diameter	14.5" (369 mm)
Antenna Height	24.0" (609.6 mm)
Radome Material	ASA
Radome Color	Gray, Brown and Black
Environmental Rating	Outdoor
Wind Survival Rating	150 mph (241 km/h)

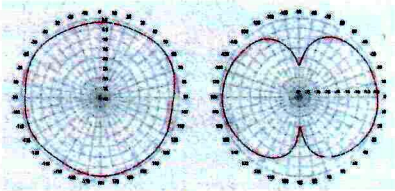
RFD#: 7583; Revision: R1 ; Release Date: May 26, 2021;

GALTRONICS
A Baylin Technologies Company

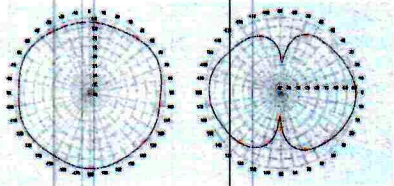
2D Antenna Patterns



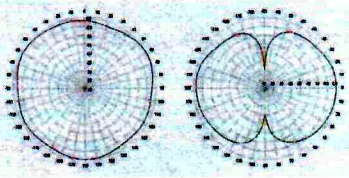
617 MHz



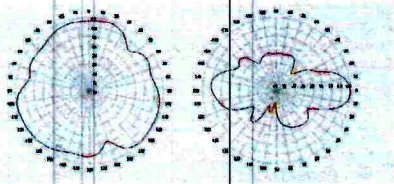
680 MHz



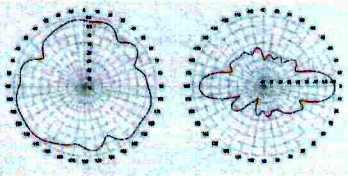
722 MHz



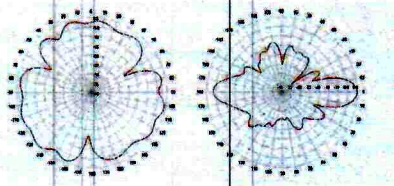
746 MHz



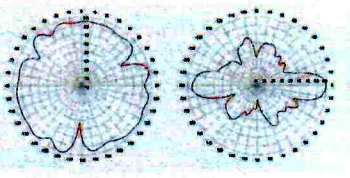
1800 MHz



2200 MHz



2496 MHz



2690 MHz

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