

Declaration in regard to the SpaceX Starlink™ network

By Ben Levi, B.S., and Paul Héroux, PhD

Purpose: The purpose of this declaration is to point out deficiencies in the Radiation Hazard Report filed by Space X in support of the FCC's Radio Station Authorization and support an Environmental Assessment of the whole satellite/ground station program.

Credentials: Ben Levi, B. Sci. — Ben Levi graduated summa cum laude in Engineering Science, and has worked in the Information Technology field for 35 years. He is a systems designer with a broad understanding of many aspects of engineering, and is qualified to comment on the satellite-based internet services programs.

Dr. Paul Héroux is a scientist with experience in physics (BSc, MSc and PhD), engineering (15 years), and the health sciences (30 years). He started his research career at Institut de Recherche d'Hydro-Québec in Varennes, Québec, an internationally reputed electro-technical laboratory. After rounding out his formation with courses in Biology and Medicine, he became interested in public health, and was appointed Associate Professor at McGill University's Faculty of Medicine, where he is the current Occupational Health program Director, and also Medical Scientist in the Department of Surgery of the McGill University Health Center.

Background

SpaceX has filed a [Radiation Hazard Analysis:Fixed Customer Premises Earth Station Terminal](#) report (“Report”) that it is utilizing as a “routine environmental evaluation” to satisfy Rule 1.307, claiming no environmental impact from its deployment of one million ground-based customer premises terminals (“CP terminals”) used to directly communicate to its Starlink satellite mega-constellation. This Declaration challenges the Report's conclusions. It refutes SpaceX's claim of no adverse environmental impact from the aggregated Radio Frequency Radiation (RFR) exposure of its proposed one million CP terminals. This Declaration contends that an Environmental Assessment is required for the whole satellite/terrestrial program, including the blanket license to SpaceX for one million earth stations.

Maximum Permissible Exposure (“MPE”)

The FCC has set the Maximum Permissible Exposure limit for RFR for people living in the U.S., based on the [OET Bulletin 65](#) from August 1997, at 1 mW/cm², or 10,000,000 μW/m². This MPE limit is predicated on the assumption that health risk is based only on thermal effects on tissues (specific absorption rate (SAR)), which was the industry consensus back in 1997. However, in the subsequent 20+ years, wireless radiation has increased exponentially, from second-generation (2G) cellular phone frequencies (<1.9 GHz) used sparingly among the public, to ubiquitous exposure of fourth-generation (4G, up to 6 GHz) and now fifth-generation (5G) frequencies in the range of 20 GHz and higher. Also since that time, there have been [thousands of scientific studies](#) confirming the adverse effects of non-ionizing radiation on living beings, including humans. [Dr. Paul Heroux](#) and others have compared the FCC's insistence on 1997-based MPE limits to more recent MPE limits set by other countries, and the differences are striking (units are μW/m²):

FCC	Austrian Medical	EUROPAEM for Sensitive Population	Bioinitiative
10,000,000	Peak < 1.0	0.1	1,000 (2007), 1.0 (2012)

As Heroux and others have made clear, the FCC’s MPE levels may be many orders of magnitude too high in order to protect the public from RFR harms. Still, 1 mW/cm² is the MPE limit for General Population/Uncontrolled Exposures to which the Report has stated each CP Terminal conforms, and it is that which will be addressed next.

The Report’s Power Density Calculations

The maximum power density calculation was done at the Antenna Surface with Beam at Slant = 0.99 mW/cm² which is as close to the FCC’s MPE limit as one can get (to the 2nd decimal place). It is fairly obvious that the numbers were manipulated in some fashion in order to keep the maximum just under the FCC’s MPE limit, and the question is where? The answer is on page 1 of the Report with the duty cycle of the uplink transmissions, in which the report states:

“The duty cycle of the uplink transmissions is controlled by the network and independently monitored by the software controlling the CP terminal; this ensures that the transmit duty cycle of a terminal cannot exceed 11% under any circumstances.”

An extensive web search was unable to verify anywhere that every CP Terminal will have a maximum transmit duty cycle of 11% -- meaning that in any given time period, the antenna will only be transmitting (emitting RFR) a maximum of 11% of the time. Perhaps the Report’s author is privy to information not publicly available, but it defies logic to assume that the transmit duty cycle will *never* exceed 11%. During operations such as file transfers, the duty cycle can be as high as 99% (e.g. [here](#)) Yet that number, 0.11, is *required to be that low*, in order to keep the Maximum Power Density with Beam at Slant under the FCC’s MPE limit. If indeed it is reasonable to assume the maximum duty cycle would be much higher, say at least 8x higher if not more, then each CP Terminal would not only exceed the 1 mW/cm² MPE at the antenna surface (0.99 x 8 = 7.92 mW/cm²), but also in Near Field (0.56 x 8 = 4.48 mW/cm²) and Far Field (0.13 x 8 = 1.04 mW/cm²) with Beam at Slant. Note that in most instances, the closest distance human beings will get to the CP Terminal will be somewhere between the Near Field length (2.78m) and Far Field (6.68m), but **once the transmit duty cycle is adjusted to a more appropriate level, it is clear that each CP Terminal will certainly exceed the FCC’s MPE limit for RFR.**

Uplink Issues

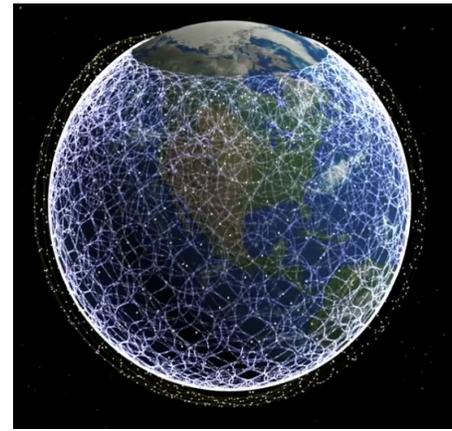
On page 2, the Report states, “There is no difference in transmit power *between CP terminals* at the center or edge of the spot *or between clear sky or heavy rain conditions.*” (emphasis added) This appears to be an error, in that CP Terminals are not designed to transmit and receive signals *between* one another -- every CP Terminal’s communication is with one or more Starlink satellites, and then connected to the internet through an appropriate protocol such as Ethernet.

According to SpaceX's FCC filing, "...these earth stations will transmit in the 14.0-14.5 GHz band and receive in the 10.7-12.7 GHz band." These frequency ranges are in the Ku band, which is notorious for "rain fade" and "snow fade," which requires that the CP terminal increase its power output in order to overcome signal degradation due to ice, clouds, rain, snow, etc.

Basically, the worse the weather conditions, the more RFR the CP terminal has to transmit in order to keep the connection to the satellite(s), and thus the more harmful RFR exposure to humans. It goes without saying that the more satellites the CP Terminal remains in contact with during inclement weather, the higher the likelihood the CP terminal's transmit power will be at a maximum.

Downlink Issues

As stated in the Application for Expedited Review, notwithstanding that earth stations and satellites form one wireless infrastructure, the FCC and applicant companies like SpaceX are approaching the program in a piecemeal fashion, seeking approval in each case without any regard to the whole. But as Professor Heroux mentions, the whole planet will be irradiated by thousands of SpaceX and other satellites, each beaming down RFR to many CP terminals and larger base stations in a many-to-many relationship, blanketing the Earth, and every living being on it with RFR. The consequences of this are totally unknown, and have never been modeled publicly, let alone studied. The above image depicts what this RFR blanket may look like.



The FCC is basically forcing every being on the planet to be irradiated with RFR, whether they consent to it or not. It should also be noted that research concludes there are currently no maximum transmit power limits for satellites, so the cumulative effect of tens of thousands of satellites all beaming down RFR, with no limits on power transmission, onto every living creature on Earth, is certainly something the U.S. government, and all governments, must study before subjecting the planet and all living things to RFR levels never before seen on Earth.

Conclusion

The Report by SpaceX does not accurately portray the RFR emissions from its CP terminals, which likely exceed even the FCC's MPE levels set over 20 years ago, and which it refused to reduce to lower limits just last December. A full Environmental Assessment must be done not only on the CP terminals, but on the whole satellite internet experiment *before* every living being on the planet is irradiated without their consent with RFR that has unknown health and environmental consequences. In the meantime, all earth station deployments should be postponed until such time as all of the issues stated herein have been addressed.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on April 17, 2020.

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