Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of

Petition for Declaratory Ruling Regarding Treatment of Rulemakings and Waivers Related to New Equipment and Services at Frequencies Greater Than 95 GHz	))))	ET Docket 13-259

Comments of Daniel Mittleman
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I am a Professor at Rice University in Houston Texas. I am submitting this comment on behalf of myself and 35 of my colleagues (several of whom have co-signed this document), not only at Rice University but also at several other US universities including Texas A&M University, the University of Texas at Austin, and the University of Texas at San Antonio.

For 20 years, my area of specialization has been the science and technology of sub-millimeter and terahertz waves, and their uses in spectroscopy, imaging, and sensing. I and my colleagues feel very strongly that this region of the spectrum is poised to have an enormous economic impact. This feeling is based on the rapid pace of technological progress in the field, as well as the astounding acceleration in recent interest on the part of many companies, both in the US and abroad. We feel that this impact will be felt in many different areas. One obvious example in which submillimeter waves will play a crucial role is the area of wireless communications; however, many other examples are in the works, with some already in deployment. We are submitting this comment to provide our perspectives about the technological areas in which submillimeter waves will play a critical role in the near future. It is our hope that these considerations will inform the FCC's future decisions regarding this fruitful region of the electromagnetic spectrum.

One key concern is in the area of future wireless technologies. It is clear that there is an upper limit to the data transfer rates on existing networks, and that we are rapidly reaching that limit. It is also

clear that demands for so-called ‘big data’ will continue to grow exponentially for at least the next several years (if not longer). This confluence of events will, without any doubt, overwhelm the capacity of existing network infrastructure. One solution that is gaining favor among researchers, as well as groups such as the IEEE 802.15 Terahertz Interest Group, is the idea of developing new network capabilities, not to replace but to supplement the existing cellular architecture. These new capabilities would rely on a higher carrier frequency, with a shorter range but massive (by current standards) bandwidth for high-data-rate transmission. Modeling indicates that various bands within the 100 GHz – 1 THz range can be used in such applications, for backhaul between small cells, as well as for bursty download links. This range of frequencies is simply better suited to transporting large data than the already over-utilized frequencies in the GHz range. These frequencies would coexist and not interfere with the existing cellular and Wi-Fi infrastructure. As an additional side benefit, routing big data to a sub-millimeter layer would provide the opportunity to return much of the existing cellular spectrum currently tied up with data delivery back to enhance the capacity of voice services.

In addition to this vision for future wireless data services, a host of other applications using the same spectral range are already in development, or in deployed use. Low-power short range terahertz systems are already being used for sensing, imaging, package inspection, and quality control, in a variety of manufacturing and process environments, both in the US and overseas. This technology space already includes a number of companies in the US, both large and small, who sell systems that use terahertz radiation, and their number is growing rapidly. The ongoing advances in terahertz technologies, including rapid developments in silicon CMOS-based solutions, quantum cascade lasers, and terahertz and sub-millimeter-wave components, will continue to accelerate these trends. All of this effort is driven by compelling needs. There are many sensing and imaging tasks for which radiation in this spectral range is simply the only solution; in other cases, terahertz imaging systems may provide a more cost-effective or less hazardous alternative to other more conventional technologies such as x-ray imaging or beta gauges. Terahertz systems are projected to constitute a $0.5 billion market by 2021. Clearly, issues of regulation

and spectrum allocation will have a significant impact on US competitiveness in this burgeoning technology space.

My colleagues and I are in the process of creating a university-based center known as the Center for Applied Terahertz Systems (CATS). The goal of this Center will be to create collaborative research and development projects between our academic partners and a group of industrial affiliates from the US and around the world, all working towards the development of terahertz imaging and communications systems. We envision a ten-year goal of creating a commercially viable multi-node mobile wireless network operating in the sub-millimeter range, and an imaging system with spectroscopic capabilities and video acquisition rates. We will produce a diverse and highly skilled group of students with a strong background in this technology area, to provide companies with the trained workforce necessary to sustain these efforts. Critically, this Center will also serve as a nexus for conversations about spectrum allocation, regulation, health and safety considerations, and the development of standards. We will invite all of the various stakeholders with concerns about future uses of sub-millimeter waves to engage in the Center. This will provide a central point from which informed policy recommendations can be developed.

As the leader of this group of the nation's foremost experts in terahertz and sub-millimeter-wave science and applications, I urge you to carefully consider all of the envisioned uses of these technologies in your deliberations. Our strong opinion is that technologies which exploit terahertz and submillimeter waves are poised to have a significant economic impact in the near future, creating jobs and stoking innovation in the US and abroad. Federal agencies such as FCC are in a position to foster this emerging area, to help maintain our nation's competitive position. With many exciting new technologies on the near horizon, the time to begin this discussion is now.

I am at your disposal as a resource for further information or discussions, should the need arise.

Respectfully,

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