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To : Ms Marlene H. Dortch, Secretary,  
Federal Communications Commission  
45 L Street N.E.  
Washington D.C. 20554  
*by web upload*

April 21st 2021

Re: SpaceX/Starlink modification proposal  
IBFS File No. SAT-MOD-20200417-00037

Dear Ms Dortch

I am writing to propose that the FCC deny or indefinitely defer this application, and any similar upcoming proposals by other companies, to allow a variety of stakeholders around the globe to complete a thorough review and study of the consequences, and debate a new and improved co-ordinated regulatory framework. I think history will not forgive us if we proceed with too much haste. This decision is not just about the Starlink project itself, or the US alone. Permission to proceed could open the international floodgates.

**My background.** I write both as a concerned citizen and as a professionally affected academic astronomer. I am not a member of the various technical working groups that some of my professional colleagues have set up, but I have published a book, called *Losing The Sky*, which provides a non-technical summary and analysis of the issues from a personal and societal perspective, intended for the general public. I am British, not American, but this is a US decision that will affect the world. Finally, I should stress that I write in a personal capacity, not formally as a representative of any working group, professional body, or of my institution.

**Context.** The population of active satellites has grown steadily for decades, to around 2000 in mid-2019, but has accelerated over the last two years, almost entirely due to the SpaceX Starlink project. In round numbers (the precise details keep changing) they have, as I understand it, firm permission for 1,600 satellites, provisional permission for another 2,800, and a proposal for 30,000 more. The current “modification” proposal for the +2,800 objects changes so much that it should be considered a new proposal. Meanwhile the pressure is building up behind the flood barrier. Many other companies and nations are planning Low Earth Orbit (LEO) constellations. In few years time, there could well be 100,000 or even more LEO satellites.

**Threat to astronomical science.** Starlink satellites are already regularly “photobombing” observations from both the ground and from space, and look likely to drown out a significant fraction of observations with the new generation of radio telescopes such as the Square

Kilometre Array (SKA). SpaceX should be commended for engaging with the scientific community to experiment with mitigations such as darkening satellites and providing orbital predictions, but these make only a modest difference, and we cannot guarantee that other companies and countries will be as co-operative. Many individual astronomers and working groups have worked very hard at calculating the effects and proposing further mitigations, but of course the best mitigation is simply not to launch so many satellites. It all seems a classic example of the “displaced cost” problem that environmentalists are familiar with. Astronomical science will not be completely destroyed, but it will cost the taxpayer billions more dollars than it would otherwise have done.

**UN process.** As I write, the scientific and technical subcommittee of the UN Committee On Peaceful Uses of Outer Space (COPUOS) is considering the report written by the “Dark and Quiet Skies” working group, led by Dr Constance Walker, and the full committee will discuss the report in August. COPUOS is also actively debating the issue of space debris. The likely result on both questions is that COPUOS will require further work and debate. It makes sense to delay decisions on LEO licenses at least until the UN achieves an international consensus.

**Public right to the sky.** The sky is like nature, or the sea, or the air that we breathe, in that people around the world have a right to expect that it belongs to everybody. Private corporations or state actors should not damage or limit public enjoyment or access without permission or consequence. When you launch from California, within an hour you are polluting France and Morocco. SpaceX may be able to largely ameliorate the damage for casual naked-eye viewers, but not for the many millions of keen amateur stargazers with binoculars, telescopes and cameras. Furthermore, we cannot guarantee that other companies and nations will be so careful, or that they will not launch huge corporate sky-adverts.

**Sustainability of space industry.** Tracked debris outnumbered active satellites by an order of magnitude, and even then is only the tip of the iceberg, leading to fears of a “Kessler syndrome” runaway, making space industry increasingly non-viable. This isn’t a question of some sudden catastrophe, but rather of the “boiling the frog” problem. As things get slowly but systematically worse, there is no clear threshold, but eventually you are dead. Once again, SpaceX and others have tried to take debris seriously, space agencies and academics are working on these issues, there are improved international guidelines, and some companies (e.g. Astroscale) are experimenting with debris clearance, but we are nowhere near having a proper understanding of the problem. It is reckless in the extreme to increase the satellite population by a factor of a hundred before we do.

**The latency question.** Widespread internet connection is solvable without large LEO constellations. Massive LEO infrastructure is driven by a perceived need for the shortest possible signal delay, i.e. latency. Very short latency is not necessary for most digital needs, but may be desirable for some applications, such as high frequency trading, real time gaming, surveillance, and driverless cars. However, just exactly how short is short enough, and over what distance, is not always clear, and needs better study before allowing “latency” as a shorthand buzzword to drive decisions with big consequences. If we consider various figures of merit such as bandwidth, ubiquity, reliability, and latency, the environmental damage we are worrying about comes almost entirely from the latency driver. Figures of merit should therefore not be bundled into a combined score, but each tensioned separately against their costs.

**The internet as an international infrastructure.** Most nations find a sensible balance between public infrastructure and private enterprise. When the state provides the roads, private enterprise can boom. Public infrastructure can of course be guaranteed by the state while being

outsourced to private enterprise. There is rightly much debate about what to leave to private enterprise and what to organise communally, and every nation finds its preferred solution. However the internet may be a special case, so important to humanity at large, and so much the bedrock of modern economic activity, that it should be globally organised or guaranteed even if privately contracted. For the software standards that underpin the internet, this is already the case, with huge success to the benefit of all humanity. ICANN, the IETF, and the W3C do not belong to any one nation or corporation; all collaborate fruitfully. There is a possible argument that this should also be the case for the physical infrastructure underpinning the internet. A number of models are possible mixing co-operation and competition in various ways. Again, I think the message is that we should slow down and think this through properly.

**Weakness of regulatory framework.** For historical reasons, regulation concerning space activity is dominated by radio communications concerns, but we are rapidly moving into a New Space Age where the issues are much wider, including public environmental damage, internet infrastructure, scientific and technological activity, military and intelligence issues, economic viability, and fair commercial competition. Meanwhile the existing international framework sets only very loose principles, with an optimistic assumption that each nation embodies those principles in their own laws. There is no real dispute resolution mechanism, but serious disputes are surely looming. There is a Liability Convention, but it is weak, and has only been used once. Regulations on ownership positively discourage debris clearance. In various ways, it seems clear that the regulatory framework is no longer fit for purpose. Things are bound to change. The FCC needs to carefully consider its role in that evolution, and to avoid taking actions that soon will seem badly inconsistent with the new international framework that will have emerged.

**Analogy with the Law of the Sea.** The evolution that I have suggested above is similar to the transition that occurred a few decades ago regarding the law of the sea. Historically, each nation tightly controlled a narrow strip of coastal waters, but the open seas were free for all to enjoy and exploit. This broke down during the twentieth century because of fishing rights and mineral rights, and the seas were becoming the scene of great commercial and international tension. After some years, the result was a greatly improved framework, and two new international bodies with real teeth.

You will I hope detect a consistent theme in this letter. We are heading rapidly towards a rather crazy situation, and should instead allow time for proper study and debate, to the eventual benefit of all.

Yours sincerely,

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