Viasat response to the Body of European Regulators of Electronic Communications (BEREC) Draft BEREC Work Programme 2023 (Consultation)

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Viasat welcomes the opportunity to comment on BEREC's proposed work programme in 2023 ("Consultation").[1] As a global industry leader, Viasat has been a strong promoter of responsible practices and regulations designed to ensure that the shared orbital environment remains available for all to use safely and equitably. Viasat welcomes critical initiatives proposed to be taken by BEREC in 2023, including a workshop[2] on secure and reliable connectivity in Europe from low earth orbit (LEO) satellite constellations. This Consultation and the planned workshop are timely and important because we are witnessing an era of unprecedented activity and innovation in space, which requires regulators to have a particularly sharp focus on ensuring the safe and efficient use and sharing of scarce spectrum and orbital resources.

Viasat looks forward to supporting BEREC on the Draft Work Programme for 2023 outlined in the Consultation. Viasat takes particular note of Section 1.6 of the Consultation regarding the workshop on secure and reliable connectivity in Europe from LEO constellations and recommends a number of topics that should be addressed in that workshop when considering the challenges raised by LEO satellite systems.

Reliable access to both sufficient spectrum and other orbital resources are key drivers in the ability of satellite services, to meet the evolving commercial, civil and military needs. A growing recognition exists that there are constraints on the exploitation of LEO, which have been expressed alternatively as environmental limits [3] and "carrying capacity."[4] Regardless of the terminology, the critical point is that LEO (like all NGSO) orbital resources are *limited* and must be carefully managed to ensure that all needs for satellite-based services can be met—including new applications for remote sensing/earth observation, science, defence, position, navigation and timing, and communications, alike.

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1 Consultation: "Public consultation on the draft BEREC Work Programme 2023", https://www.berec.europa.eu/en/public-consultations/ongoing-public-consultations-and-calls-for-inputs/public-consultation-on-the-draft-berec-work-programme-2023.

2 Section 1.6 of the Draft BEREC Work Programme 2023

3 *See, e.g.*, European Space Policy Institute, ESPI Report 82 - Space Environment Capacity – Full Report (April 2022), https://espi.or.at/news/espi-report-82-space-environment-capacity; L. Miraux, "Environmental Limits to the Space Sector's Growth," *SCIENCE OF THE TOTAL ENVIRONMENT* 806, 4 (Feb. 2022), https://www.sciencedirect.com/science/article/abs/pii/S0048969721059404?via%3Dihub. ("A common assumption is that limitations to the human enterprise in space are of a purely technical land economic nature. This paper challenges this assumption, by highlighting the existence of environmental limits to the currently planned development of space activities. Risks arising from these limits are explored, and the importance of eco-design in the space sector is emphasized."); A. Boley & M. Byers, "Satellite Mega-Constellations Create Risks in Low Earth Orbit," *SCIENTIFIC REPORTS* 11**,** 10642 (2021), https://doi.org/10.1038/s41598-021-89909-7, at 1-3.

4 *See* M. Sturza, M. Dankberg, and W. Blount, LEO Capacity Modeling for Sustainable Design, Advanced Maui Optical and Space Surveillance Technologies Conference, Sept. 27-30, 2022.

1. Undue consumption of scarce spectrum and orbits.

At this early stage of the New Space Age, we are seeing a few actors in LEO staking claims to vast amounts of spectrum and orbital resources in a manner that can hinder competition from, and innovation by, others. These very real risks, include:

- Creating impermissible interference into GSO networks that interrupts broadband and direct-to-home video (DTH) operations and reduces network capacity;
- Threatening equitable access by other NGSO systems to shared NGSO frequency bands; and
- Impairing safe and reliable access to wide swaths of LEO that need to be shared with so others can provide spectrum-based services.

Viasat has addressed these risks in greater detail in consultations with Member States, including Ireland,[5] and commends BEREC to that detailed analysis. By addressing these risks now on a pan-European basis, Europe can ensure that its policies keep pace with changes and innovations in the space sector and that opportunities continue to exist for robust competition in the provision of satellite-based services throughout Europe. These actions should include mitigating the risks of interference from NGSO systems into GSO networks, and between NGSO systems, and ensuring that the spectrum and orbital resources are shared equitably among NGSO systems.

2. Increasing orbital debris and collision risk.

Another challenge involves the growing amount of orbital debris in LEO and the increasing risk of collisions.

European economy and society are increasingly reliant on space services (such as location services, satellite-based media services, weather forecasting, and emergency services). This growing reliance of GDP on space comes with the need to avoid and mitigate risks of disruption to space-based assets and infrastructure from a growing amount of orbital debris, the growing congestion in LEO, and the trend toward larger and more numerous LEO satellites, which increases the likelihood of collision events that can disable and even destroy satellites, and also generate more orbital debris.[6]

Each collision in LEO will statistically lead to more collisions and ultimately can lead to a "belt of debris around the Earth,"[7] causing a series of self-sustaining collisions referred to as the Kessler syndrome, which could make certain orbits unusable for critical civil, military and commercial space services. One notable study commissioned by the U.S. National Science Foundation (NSF) indicates that it may not be feasible to sustain the deployment of one large NGSO system over time as a result of these dynamics. That NSF study forecasts a dramatic increase in both space collisions and new debris, starting within just a few years; in the longer term, "satellites are destroyed [by collisions with debris]

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[5] *See* Commission for Communications Regulation (COMREG), Ireland, consultation on "Review of the Satellite Earth Station Licensing Regime - Response to Consultation and Further Consultation", (released 4 July 2022); Viasat comments submitted 15 August, 2022 (available when published by COMREG), https://www.comreg.ie/publication/review-of-the-satellite-earth-station-licensing-regime-response-to-consultation-and-further-consultation.

[6] *See generally* A. Lawrence, M. L. Rawls, M. Jah, A. Boley, F. Di Vruno, S. Garrington, M. Kramer, S. Lawler, J. Lowenthal, J. McDowell, and M. McCaughrean, "The case for space environmentalism," *NATURE ASTRONOMY* 6 (Apr. 22, 2022), https://www.nature.com/articles/s41550-022-01655-6.

[7] *See* D. Kessler and B. Cour-Palais "Collision Frequency of Artificial Satellites: The Creation of a Debris Belt." *JGR SPACE PHYSICS* 83, A4 (June 1978) https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/JA083iA06p02637

faster than they are launched."[8] Another study concludes that "Kessler Syndrome is expected to occur in low-Earth orbit around 2048 under recent historical sectoral growth trends, and may occur as early as 2035 if the space economy grows consistent with projections by major investment banks."[9]

Notably, the massive increase in LEO constellation sizes is driving an exponential increase in the number of conjunctions (*i.e.,* "close calls") that a given constellation can be expected to experience over time—dramatically increasing the likelihood of an in-orbit collision that would have devastating impacts on space sustainability and safety.[10] As one leading expert explains: "The law of very large numbers will tell you that very low probability events can happen if given enough opportunities."[11] However, no current rules or guidelines reflect the magnitude of these dangers.

The collision risk is further exacerbated by the documented failure rates of satellites in certain LEO constellations: indeed, satellites that cannot maneuver cannot avoid collisions, and experiential failure rates early in the life of one constellation demonstrate that it has not been capable of maintaining a sufficiently low level of disposal reliability.[12] Moreover, all potential collisions cannot be predicted, and even where a satellite is maneuverable, all potential collisions cannot be avoided.[13]

Failures and collisions of this sort would affect far more than the satellites in the LEO constellation itself. Failed LEO satellites, collisions involving LEO satellites, and the resulting debris fields, would affect all individual satellites and constellations that occupy, or transit, the same or overlapping orbits, potentially disrupting the operation of other critical satellite systems, including those in LEO and beyond. And both failed satellites and catastrophic collisions would make the orbital environment more crowded and dangerous and make access to space more costly and risky for others—including satellites that provide DTH and broadband communications services (including those programs exported by Europe to other countries), as well as those that provide critical space-based observations for weather forecasting, climate monitoring, and earth sciences, and PNT.

These harms would also include the costs and risks related to designing NGSO satellites and constellations to operate in a more crowded (and dangerous) environment, the risks and delays associated with launching satellites into and through those crowded environments (on the way to higher orbits, including GSO orbit), and the risks associated with deorbiting satellites through those crowded orbits at end of life.

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8 *See* G. Long, "The Impacts of Large Constellations of Satellites," JASON – The MITRE Corporation, JSR-20-2H, Nov. 2020, (Updated: Jan. 21, 2021), at 97, https://www.nsf.gov/news/special_reports/jasonreportconstellations/JSR-20-2H_The_Impacts_of_Large_Constellations_of_Satellites_508.pdf.

9 *See* A. Rao and G. Rondina, "Open access to orbit and runaway space debris growth," *ARXIV* 2202.07442 [econ.GN].

10 *See* Comments of NASA, U.S. FCC IBFS File No. SAT-AMD-20210818-00105, at 1 (filed Feb. 8, 2022) ("NASA Letter") (With the increase in large constellation proposals to the FCC, NASA has *concerns with the potential for a significant increase in the frequency of conjunction events and possible impacts to NASA's science and human spaceflight missions*."); ("An increase of this magnitude into these confined altitude bands inherently brings *additional risk of debris-generating collision events based on the number of objects alone*.) (Emphasis added).

11 *See* H. Lewis, https://twitter.com/ProfHughLewis/status/1509903335251456045 (Apr. 1, 2022).

12 *See* "Jonathan's Space Pages: Starlink Statistics," https://planet4589.org/space/stats/star/starstats.html (detailing a variety of types of failures and anomalies involving Starlink satellites).

13 *See NASA* Letter at 3 ("[C]onsidering multiple independent constellations of tens of thousands of spacecraft and the expected increase in the number of close encounters over time, the assumption of zero risk from a system-level standpoint lacks statistical substantiation.") (emphasis added).

Furthermore, in a landmark report, the Organization for Economic Cooperation and Development (OECD) points to the growing risk of an irreversible environmental and industrial disaster in space.[14] The deployment of large LEO constellations outside a clear framework and regulation for the preservation of LEO, therefore, poses a potential direct threat to the function of key space-based systems that are coming online now and which Europe may derive benefit in the future, such as Galileo, Copernicus, and the new EU Secure Connectivity constellation, which in turn "would have a direct impact upon the security, safety, economy and well-being" of citizens.[15]

3. Environmental harms.

The increased use of LEO is not without cost to the environment. The rapid development of large LEO constellations risks multiple tragedies of the commons, including tragedies to ground-based astronomy, Earth orbit, and Earth's upper atmosphere.[16] Those costs include: (i) the potential for large quantities of satellites re-entering the atmosphere to damage the Earth's atmosphere and effect climate change through, among other things, radiative forcing,[17] and depletion of the ozone layer, increasing the risk of cancer and other negative health effects,[18] (ii) impairing critical optical and radio astronomical research by disrupting the visible night sky,[19] (iii) creating light pollution, with the

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[14] *See* "Space Sustainability: The Economics of Space Debris in Perspective," OECD Science, Technology and Industry, Policy Papers, No. 87 (Apr. 2020), https://www.oecd.org/fr/environnement/space-sustainability-a339de43-en.htm.

[15] *See* European Commission, Joint Communication to the European Parliament and the Council, "An EU Approach for Space Traffic Management; An EU contribution addressing a global challenge" (Feb. 15, 2022), https://ec.europa.eu/info/sites/default/files/join_2022_4_1_en_act_part1_v6.pdf.

[16] *See* A. Lawrence, M. L. Rawls, M. Jah, A. Boley, F. Di Vruno, S. Garrington, M. Kramer, S. Lawler, J. Lowenthal, J. McDowell, and M. McCaughrean, "The case for space environmentalism," *NATURE ASTRONOMY* 6 (Apr. 22, 2022), https://www.nature.com/articles/s41550-022-01655-6;

Letter from Natural Resources Defense Council and the International Dark-Sky Association to U.S. FCC, IBFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (Sep. 7, 2022) ("NRDC & IDA Letter");

See A.C. Boley and M. Byers, "Satellite mega-constellations create risks in Low Earth Orbit, the atmosphere and on Earth," *SCIENTIFIC REPORTS* 10642 (May 20, 2021), https://www.nature.com/articles/s41598-021-89909-7.

[17] *See* L. Organski, C. Barber, S. Barkfelt, M. Hobbs, R. Nakagawa, Dr. M. Ross, Dr. W. Ailor, *Environmental Impacts of Satellites from Launch to Deorbit and the Green New Deal for the Space Enterprise*, Aerospace Corporation (Dec. 2020);

D. Werner, "Aerospace Corp. Raises Questions about Pollutants Produced during Satellite and Rocket Reentry," *SPACENEWS* (Dec. 15, 2020), available at https://spacenews.com/aerospace-agu-reentry-pollution/;

M. N. Ross & L. David, "An Underappreciated Danger of the New Space Age: Global Air Pollution," *SCIENTIFIC AMERICAN* (Feb. 2021), available at https://www.scientificamerican.com/article/an-underappreciated-danger-of-the-new-space-age-global-air-pollution/;

M. N. Ross and K. L. Jones, "Implications of a growing spaceflight industry: Climate change," *JOURNAL OF SPACE SAFETY ENGINEERING* 9 (3) (Jun. 6, 2022),https://www.sciencedirect.com/science/article/abs/pii/S2468896722000386;

U.S. Government Accountability Office, *Large Constellations of Satellites: Mitigating Environmental and Other Effects*, GAO-22-105166 (Sep. 29, 2022) ("U.S. GAO Report").

[18] NRDC & IDA Letter at 3.

[19] *See* A. Lawrence, M. L. Rawls, M. Jah, A. Boley, F. Di Vruno, S. Garrington, M. Kramer, S. Lawler, J. Lowenthal, J. McDowell, and M. McCaughrean, The case for space environmentalism, *NATURE ASTRONOMY* 6 (Apr. 22, 2022), https://www.nature.com/articles/s41550-022-01655-6;

resulting negative impacts on the health and quality of life of human and on plants and animals,[20] and (iv) as NASA has emphasized, impairing the functioning of critical asteroid detection and defense capabilities.[21]

4. National security concerns.

Finally, we note potential implications for national security. Space is a vital component of any drive towards the strategic autonomy of any nation, as it helps with situational awareness, decision-making, and connectivity of technologies and systems, including with national security and defense applications.

The recent ASAT test by the Russian Federation shows that hostile activities by sovereign actors in LEO represent a very significant threat to the open and safe use of LEO. The same can be said of the risk that space activities carried out by private actors can represent to all space actors, in particular through the generation of a massive number of additional space objects and the corresponding risk of collisions leading to debris creation and possibly to a Kessler Syndrome. According to an evaluation of the debris generated by the Russian ASAT, a collision between two LEO satellites would generate a similar dispersion of trackable and non-trackable debris in space.[22] Orbits made unusable by space debris would adversely affect defense and security applications in the same way as civil and commercial use cases.

Moreover, the risk of business failure in this new environment is high, and business failures can leave an operator with neither the ability nor the incentive to promptly deorbit failed satellites.

Europe should be particularly mindful of the risk that 'out-of-scale' projects in LEO like certain large constellations could pose to sovereign European activities in and from space.

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Viasat commends BEREC's intention to understand and identify regulatory challenges arising from the deployment of large LEO systems. To that end, Viasat looks forward to participating in the upcoming workshop and providing insight into the critical issues described above, with a view toward facilitating innovation and competition among a wide variety of GSO networks and NGSO systems; efficient

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C. Young, "The worst case Starlink scenario? We could be 'right on the edge' of Kessler syndrome," *INTERESTING ENGINEERING* (Aug. 11, 2022), https://interestingengineering.com/innovation/worst-case-starlink-scenario-kessler-syndrome;

U.S. GAO Report at 1;

United Nations Office for Outer Space Affairs, International Astronomical Union, IAC, NOIR Lab, *Dark and Quiet Skies for Science and Society: Report and Recommendations*, (Dec. 29, 2020), available at https://www.iau.org/static/publications/dqskies-book-29-12-20.pdf.

[20] NRDC & IDA letter at 3.

[21] NASA Letter at 3 ("[T]here would be a Starlink in every single asteroid survey image taken for planetary defense against hazardous asteroid impacts, decreasing asteroid survey effectiveness by rendering portions of images unusable. This could … have a *detrimental effect on our planet's ability to detect and possibly redirect a potentially catastrophic impact.*").

[22] *See* "Satellite Collisions Have the Same Consequences as ASAT Tests" (Nov. 2021), https://www.viasat.com/space-innovation/space-policy/space-debris/.

spectrum use; advancement of European interests; and safe and sustainable use of LEO for generations to come.