D1. Coexistence with existing systems

To provide reassurance that the quality of service of existing UK services will not be adversely affected by this licence application, Ofcom requires Telesat to demonstrate that coexistence is possible between its system and:

a) existing non-geostationary satellite systems that are already licensed in the UK;

b) NGSO satellite systems for which an application has been made and which has been published for comment on Ofcom's website; and,

c) other specific co-frequency earth stations registered with the ITU.

At the date of submitting this application, the existing NGSO licensees mentioned in point a) above are:

1. Network Access Associates Ltd (license number 1102679);
2. Kepler Communications Inc (license number 1153698); and,
3. Starlink Internet Services Limited[1] (license number 1239247).

Appendix 1 provides a technical analyses that demonstrates it would be possible for the Telesat Lightspeed ™ system to coexist with each of the above listed systems, in the absence of an agreement with the relevant licence holder(s). In particular, we demonstrate that the impact of the Telesat Lightspeed system into existing licensees, in terms of increased unavailability and of reduction in throughput, would be modest. While the Telesat Lightspeed constellation will initially comprise 188 satellites, it is planned to be expanded in a second phase to the target number of 298. Using a conservative approach, the technical analysis shows that coexistence is possible with the larger constellation of 298.

With respect to the NGSO systems mentioned in point b) above, at the date of submission of this document, no applications were published for comment on Ofcom's website[2].

With respect to the applicable specific co-frequency earth stations registered with the ITU mentioned in point c) above, Telesat is coordinating its NGSO system with the relevant operator(s) for those earth stations under the applicable provisions of Article **9** of the Radio Regulations. Telesat commits to take any necessary technical and operational measures not to cause interference into those earth stations.

D2. Coexistence with future systems

Coexistence among NGSO systems essentially involves limiting the number of, or mitigating the impact of, in-line events. When implementable in practice, mechanisms such as exclusion angles can be defined in coordination discussions to limit the number of in-line events, while dynamically assigning power and bandwidth can mitigate their impact. The possibility of benefitting from any of these techniques to accommodate future systems requires that a system be flexible, agile and technically advanced. As detailed further in Section 1.2 below, the Telesat Lightspeed system meets all such requirements, so that details on how to implement any of these techniques, when and where possible, can be discussed among the interested operators during coordination discussions. In fact,

[1] Three NGSO gateway earth station licences (licence numbers 1224918, 1242714 and 1249304) are associated to this network licence

[2] See https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/satellite-earth/non-geo-fss – URL accessed on 31 May 2022

Telesat Lightspeed can dynamically assign capacity where and as required, through the selection of the satellite chosen to deliver the service, of the size and steering of satellite spot beams, and of the amount of spectrum and power allocated to them.

D3. Competitive impact

While the coexistence aspects are addressed in response to questions D1 and D2 above, it is clear that the introduction of a system with innovative features like those of Telesat Lightspeed in the UK will widen the choice to UK customers, end consumers and citizens, boosting a healthy market competition, which, in turn, will make price offerings more attractive.

Benefits for UK customers, end consumers and/or citizens

In this section Telesat provides the foreseen impact of Telesat Lightspeed applications in terms of benefits for UK customers, end consumers and citizens. This will be preceded by a short introduction on Telesat Lightspeed architecture, highlighting some of the key innovating technical characteristics.

1. System Overview

As a leading innovating satellite operator, Telesat[3] aims at revolutionising the satellite industry and global communications through the development of Telesat Lightspeed[4] – a next-generation non-geostationary (NGSO) constellation of highly advanced Low Earth Orbit ("LEO") satellites capable of delivering low-latency, high-speed, high-capacity, secured and resilient broadband connectivity on a truly global basis.

The Telesat Lightspeed system is a hybrid constellation comprising two approximately circular orbits: the "*polar*" orbit satellites have inclination 98.98 degrees and altitude of approximately 1000 km; the "*inclined*" orbit satellites have inclination 50.88 degrees and altitude of approximately 1350 km. Together, the Telesat Lightspeed system delivers fibre-like quality connectivity with high throughput and low latency anywhere on earth. As a highly advanced and efficient system with unparalleled economies of scale (multiple Tbps of capacity), Telesat Lightspeed will serve several markets at a significantly lower cost when compared to that of traditional alternatives, based on either space or terrestrial technologies.

Telesat Lightspeed architecture relies primarily on three components:

[3] https://www.telesat.com/
[4] https://www.telesat.com/leo-satellites/

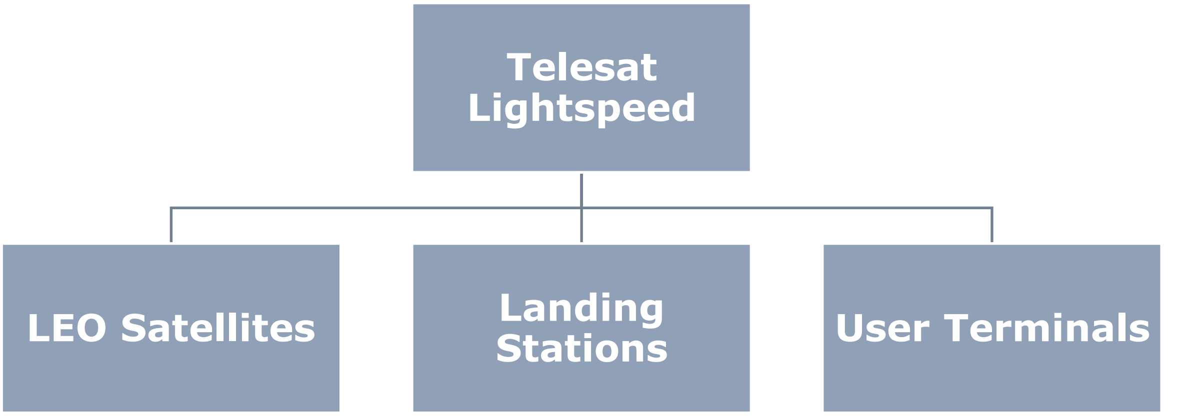

Figure 1: Components of Telesat Lightspeed

1. LEO Satellites - In the initial phase, 188 satellites plus 10 in-orbit spares will be deployed considering both polar and inclined orbits. Additional satellites will be added in a second phase, bringing the total number to 298. Polar orbits provide global coverage, with a higher concentration of satellites in the Polar Regions. Inclined orbits allow to concentrate satellites over equatorial and mid-latitude areas where demand for communications services is greater, thereby focusing most of the capacity on populated areas. By using these two complementary orbits, the system achieves true global coverage while concentrating satellite resources on the areas of greatest demand, thereby maximizing the system efficiency.
2. Landing Stations ("LS") – Also known as "ground stations" or "gateway earth stations", LS relay the user data traffic between the terrestrial network and the LEO satellites. Landing Stations consist of sites with up to 8 full motion 4-meter gateway antennas used to track the satellites within their field of view.
3. User Terminals ("UT") – Encompassing both Very Small Aperture Satellite ("VSAT") and Earth Stations in Motion ("ESIM"), UT allow for connectivity with users anywhere on Earth.

Both UT and LS can use the following portions of the Ka-band frequency band, with flexible configurable channel bandwidth of up to 400 MHz and dual circular polarization.

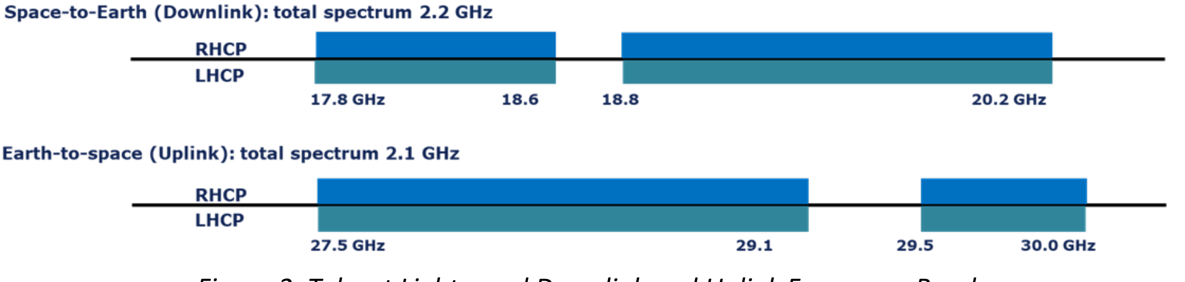

Figure 2: Telesat Lightspeed Downlink and Uplink Frequency Bands

Spectrum use in the UK will be fully compliant with the domestic allocation. In the context of this application, we would like to request Ofcom to provide authorisation to use the following frequency bands:

• 27.5 – 27.8185 GHz

• 28.4545 – 28.8265 GHz

• 29.5 – 30 GHz

Telesat is planning to begin launching its constellation in Q3 2025 with service available in the northern part of the UK (above ~55 degrees latitude) in Q1 2026 with service available throughout the UK in Q4 2026

1.1 Establishment of Data Connection

Typically, Telesat Lightspeed will be used to connect UTs and customer core networks via an LS. Direct connections to other geographically separated UTs are also possible.

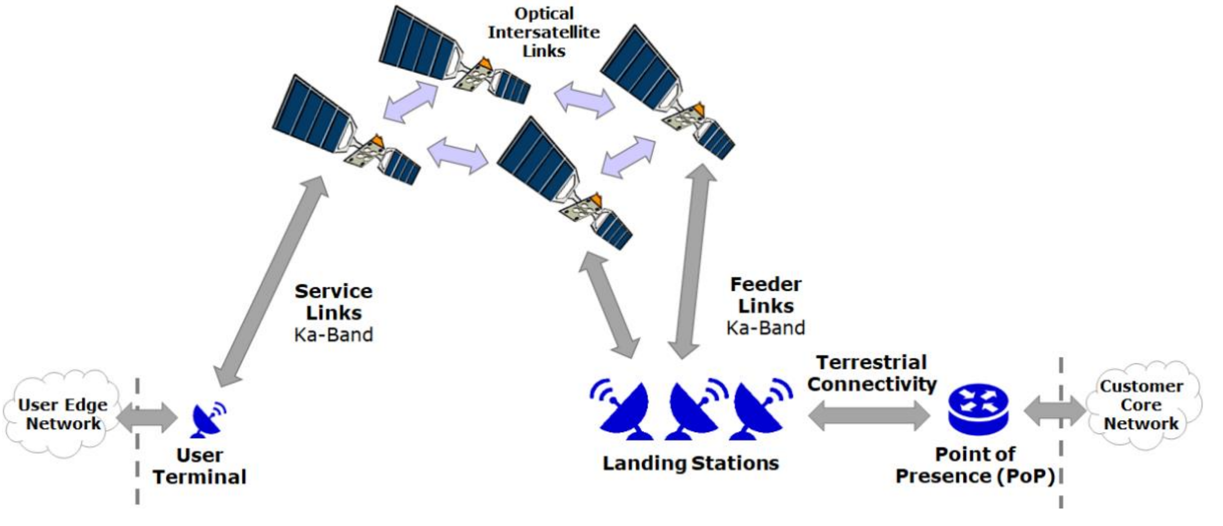

Figure 3: Tightly Integrated Satellite Communications Network

User terminals will first establish a service link directly to at least one LEO satellite through a high-gain steerable satellite spot beam.

In instances where the satellite has a direct view to an LS or a receiving UT, these user signals could then be connected directly. Where connection is made through an LS, the signal is then routed to a specific Point of Presence ("PoP") via a high capacity cable (terrestrial connectivity) which then meets the customers' core network.

In cases where the satellite has no direct field of view of the intended end point (e.g. while overflying the poles), signals could traverse through the inter-satellite links ("ISL") within Telesat Lightspeed satellite constellation to their wanted destinations. The Telesat Lightspeed system uses laser terminals on every satellite to enable ISL.

The deployment of Telesat Lightspeed technical and operational resources will be subject to and compliant with local policies and regulations in each country.

1.2 Optimised Design and Highly Flexible Network for Low Latency, High Resilience/Security, end-to-end System Availability and Regulatory Compliance

Telesat Lightspeed will dynamically assign capacity to locations and routes with high demand by varying the number and size of the satellite spot beams, as well as the amount of spectrum and power allocated to each beam. Dynamically reconfigurable beams, together with frequency reuse, result in a highly efficient use of satellite resources and spectrum. Moreover, dynamic assignment of spectrum and power to each beam allows Telesat Lightspeed to comply with local spectrum regulatory requirements and policies.

Each satellite in the constellation is capable of scanning the satellite’s entire field of view. This will allow the satellite to detect a user request to initiate communication. Sufficient beams will be generated by each satellite to provide complete field of view coverage at all times.

Incorporating the use of ISL creates a global mesh network in space. Each satellite will employ on-board processing performing signal regeneration (i.e. demodulation and re-modulation) and routing of traffic, thereby improving link performance and increasing capacity compared to a simple channeliser or bent-pipe payload. Therefore, every satellite will effectively be a node in the network. Apart from routing the intended signal through the satellites to the LS or UT that are beyond a satellite’s field of view, such a resilient configuration provides redundancy within Telesat Lightspeed space segment, with no single point of failure. This increases the system availability to Telesat’s customers, ensuring that they would have access to data anywhere and at any time

The system is also “future proof” as, due to the modular design of the orbits, capacity can be added conveniently and efficiently by adding additional planes to the orbits and/or increasing the number of satellites in the orbit(s).

Unlike geostationary and medium earth orbit satellites located at much higher altitudes, the Telesat Lightspeed satellite constellation operates in LEO which is 35 times closer to the ground. Correspondingly, this translates into an equivalent lower latency in data transmission, which is crucial at augmenting the users’ experience (such as faster loading of web pages) and increasing the types of data applications (e.gs latency- sensitive applications such as real-time communications and control) that could be supported.

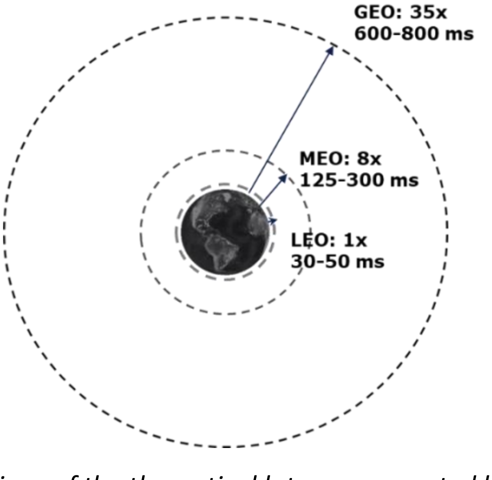

Figure 4: comparison of the theoretical latency supported by different orbits

Traditional GSO networks use modified internet protocols to accelerate unencrypted traffic to partially mitigate the impact of high latency; however, such means of accelerating traffic is incompatible with some applications, can be ineffective with encrypted traffic, and offers little benefit to highly interactive two-way applications. Hence, Telesat Lightspeed provides a better user experience, regardless of the security protocols and encryption formats being used.

Compliant with Metro Ethernet Forum ("MEF")[5] standards for seamless plug-and-play integration, Telesat Lightspeed supports quick service deployment in all use cases. This is particularly important in scenarios where time is a key factor in the establishment of reliable communications links for critical services[6].

Other key features of Telesat Lightspeed include dynamic fade mitigation techniques (adaptive power control and code modulation) through the active detection of link status to overcome adverse weather conditions anywhere in the world and the provision of one-stop live support with the regional Telesat engineering team backed by more than fifty years of experience.

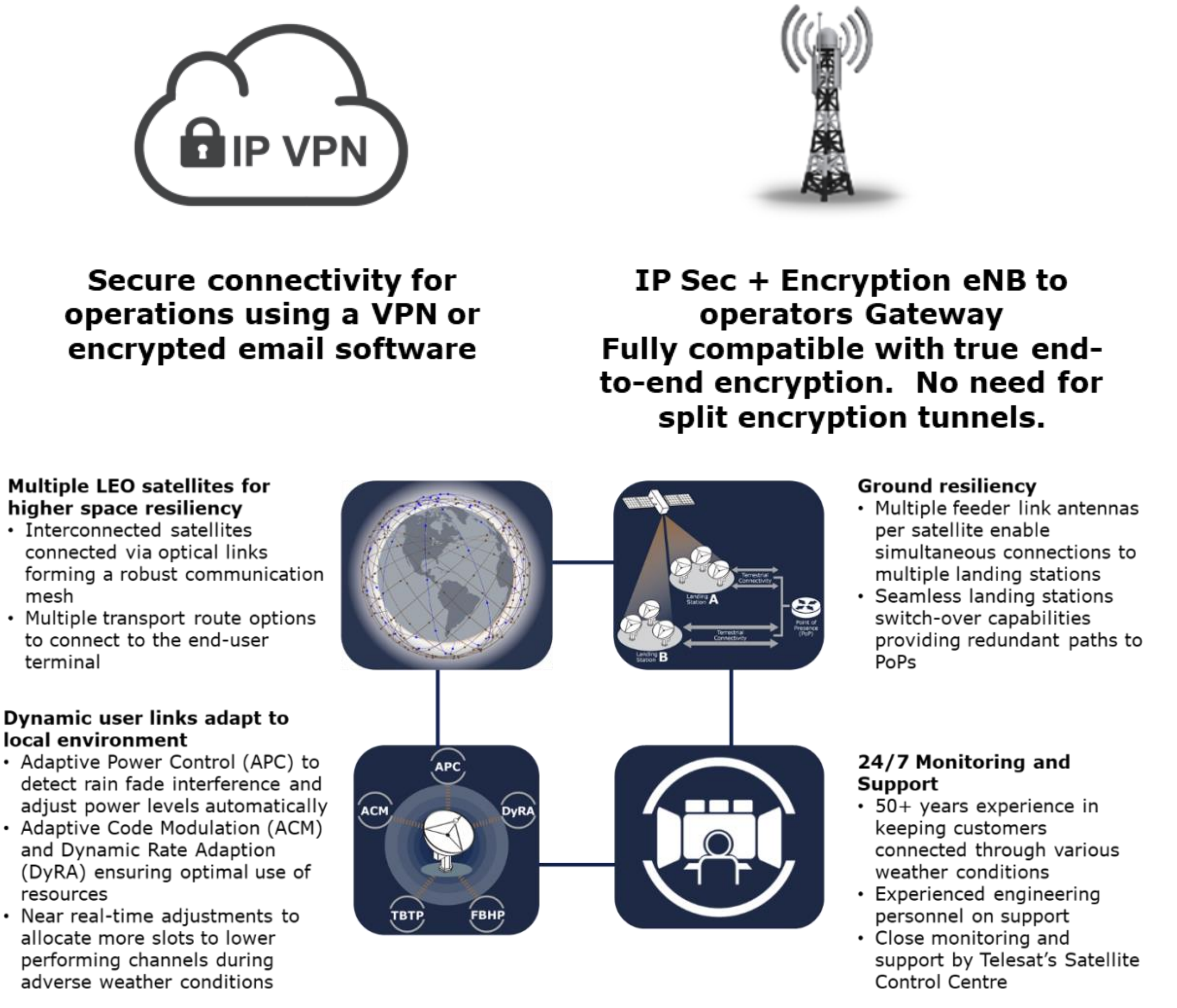

Figure 5: Summary of the main Telesat Lightspeed Features

2. System applications that are beneficial for UK customers and end customers/citizens

Telesat has been a satellite service provider for over 50 years. Telesat Lightspeed is the next step in the evolution of Telesat's services and will provide a tremendous increase in bandwidth and value-

[5] https://www.mef.net/learn/mef-technical-standards-sdks/
[6] Please refer to section 3 for further information on systems application

added capabilities to the markets Telesat already serves. Telesat Lightspeed satellite service will offer communications capabilities in areas where wired and wireless networks are absent or might not provide adequate coverage or performance compatible with the requested applications.

Telesat Lightspeed is designed to respond to the continuously increasing demand for globally available, fibre-quality broadband. Due to the system's seamless global coverage, Telesat Lightspeed user terminals will enable government, enterprise, and other users, to rely on fixed and mobile communications, with extended flexibility and reliability, in remote areas and while on the move.

In recent years, satellite services have attempted to bridge the gap of the digital divide through complementing coverage offered by terrestrial services with the provision of mobile backhaul through satellite links for local telecommunication operators. With the inherent characteristics of high throughput and low latency in the Telesat Lightspeed system, support for newer IMT technology is now even more possible, such as meeting the requirements of 5G use cases of Ultra Reliable Low Latency Comms ("URLLC") and enhanced Mobile Broadband ("eMBB"), even in geographical areas where operations of terrestrial base stations are prohibitively expensive or not feasible.

This is also of particular interest to the maritime industry (merchant, cruise, fishing, yachting) as well as aeronautical users (business, transport, and passengers), that have traditionally had only limited connectivity options available.

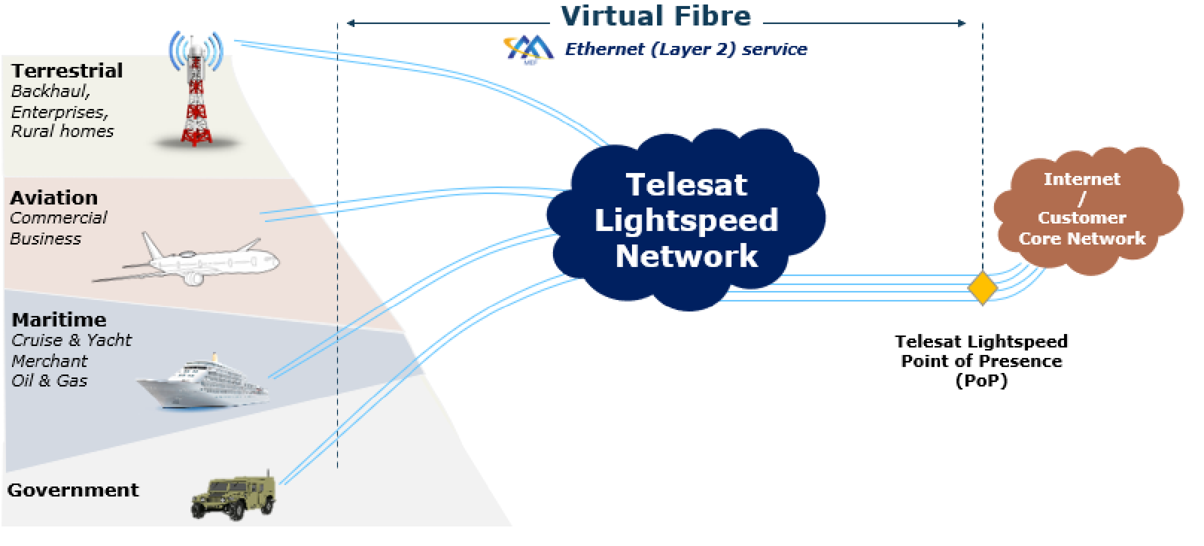

Figure 6: Fibre Quality Broadband for Multiple Markets

More importantly, Telesat Lightspeed will facilitate applications related to critical infrastructure, disaster communications, corporate communications, telemedicine and other remote communications that will positively affect users' efficiency and quality of life.

Telesat Lightspeed system can supply additional capacity quickly to areas of high demand and offer multi-Gbps speeds.

2.1 Enterprise & Telecom Usage

As a means to complement the roll-out of terrestrial mobile technologies, including 5G, and reducing the digital divide aiming at universal connectivity, Telesat plans to collaborate with telecommunications service providers in the UK to extend their existing mobile service coverage to rural/remote communities through the use of Telesat Lightspeed as a mobile backhaul network. To further expand other means of broadband provision to the remote community, Telesat Lightspeed could also be used as a fixed wireless backhaul.

Overall, Telesat Lightspeed will provide fibre-like connectivity at affordable price points that will allow Internet Service Providers (ISPs) to enhance efficiently and economically their network coverage, performance and profitability. Designed with a deep understanding of the bandwidth-intensive applications and cloud-based network connectivity that enterprise users require, Telesat Lightspeed will eliminate the hurdles that telecommunications service providers face today when incorporating satellite technologies into their networks, by:

- Providing universal connectivity by pairing Telesat Lightspeed with a telecom provider/operator’s access network in the local community to deliver an end-to-end Internet service
- Facilitating LTE/5G network expansions, leveraging Telesat Lightspeed for backhaul
- Eliminating the cost of infrastructure including the provision of “last-mile” connectivity to the rural areas while reducing the investment risks undertaken by ISPs
- Enabling quick deployable solutions fulfilling ISPs’ regulatory obligations

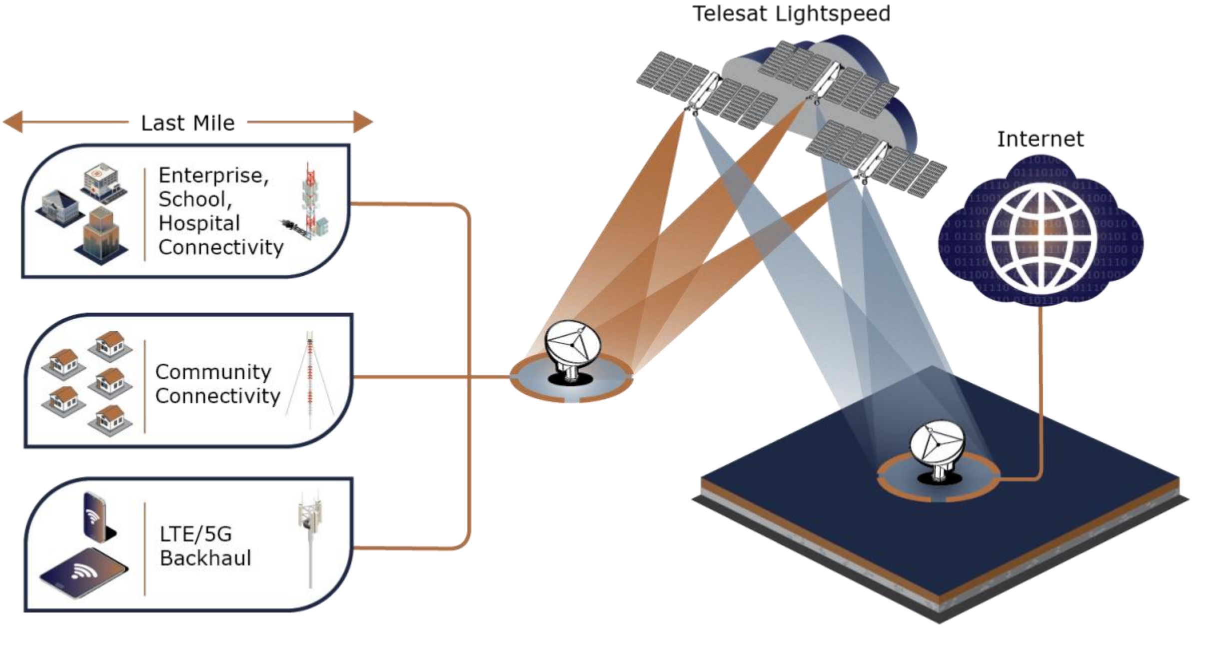

Figure 7: Provision of Terrestrial Connectivity through Telesat Lightspeed

Even in areas where terrestrial connectivity is available, Telesat Lightspeed could also be considered as the back-up link and utilised as a means of data-offloading from the fibre network during periods of high traffic utilisation or unavailability of the terrestrial network (e.g. in the case of natural disaster).

Furthermore, as a means of connecting geographically dispersed site offices under a corporate entity, Telesat Lightspeed will provide UK enterprise users an alternate form of connection to their existing links. Some of these enterprise users include applications (such as in finance) where real-time access to updated information is critical and warrants a dedicated redundancy in connectivity for their private network.

Internet connectivity delivered via Telesat Lightspeed's high-speed, low-latency backhaul will create opportunities in currently underserved areas in the UK.

Telesat has been already engaged in discussions with major mobile telecommunications operators in the UK for providing backhaul services while also considering the cost effective solution of adding a private interconnect anywhere the telecom operator needs it.

2.2 Maritime and Offshore Platforms

With true global coverage designed to serve all sea routes, including those emerging in Polar Regions, Telesat Lightspeed will meet the unique remote-to-shore connectivity requirements critical to the modern maritime industry. From the "moving city" nature of cruise ships to unique operational needs of merchant shipping, Telesat Lightspeed will offer multiple Gbps link capacity and Tbps of total capacity to meet passenger demands for seamless Virtual Private Network ("VPN"), download of encrypted web pages, e-commerce and entertainment applications, as well as real-time, high-quality internet streaming to support crews' morale, training and welfare. Telesat Lightspeed will provide an avenue for users to have the same level of connectivity and experience as those enjoyed by land-based users through the provision of highly focused capacity along popular maritime routes. The importance of this has been further highlighted in recent times during the COVID-19 pandemic, when several seafarers have been stranded on board maritime platforms due to national travel restrictions[7], placing an even greater emphasis on crew communications.

Moreover, with increased reliance on technology towards the development of autonomous and semi-autonomous, there is a higher dependency on operational information exchange in real-time with shore stations to support decision-making and optimisation of the vessel's performance. Such examples include operational features such as video monitoring, access to real-time weather and updated navigational charts. Ship operation and management such as monitoring of cargo and mechanical functions on board, online access to customs and port documentation may also utilise Telesat Lightspeed's low-latency and high-throughput dedicated communications links.

The UK has a great maritime history with prevalent presence in various sectors of the industry including Merchant Navy, Superyacht and Cruise sectors. UK is also one of the major global maritime hubs, with the English Channel being one of the world's busiest shipping routes, linking the North and Baltic Seas to North-West Atlantic. For these reasons, UK is a top priority country for Telesat Lightspeed maritime applications both for domestic and for foreign transiting vessels.

When it comes to the offshore sites, (such as oil rigs and oil exploration platforms), reliable, cost-effective communications is essential. Offshore oil and gas industry is considered as a major contributor to the UK economy. The industry employs around 375,000 people in UK and a total of £486 billion was invested in the exploration, development and production of UK's oil and gas reserves in the last four decades alone[8].

These industries can leverage low latency communications links on Telesat Lightspeed for real-time operations monitoring, as well as connectivity for employees working in these locations. Due to the higher bandwidth provided by Telesat Lightspeed when compared to other space- or terrestrial-based

[7] World Maritime Theme 2021, IMO 2021 (https://www.imo.org/en/About/Events/Pages/World-Maritime-Theme-2021.aspx).

[8] https://maritime.solent.ac.uk/maritime-industry/offshore-renewable

technologies, the provision of multiple services to a single location is also possible through the aggregation of traffic to a single user terminal antenna on area-limited platforms.

Also, as these industries move to explore new prospects that are more remote and isolated from the community, the need for an intelligent, flexible and high-performance communications infrastructure to support distant operations has become even more critical. Emphasis on real-time connectivity in access to remote sensor data is relied upon even more heavily to reduce the physical manpower on-site. In most of such instances, the cost of laying subsea cables to these offshore locations and their maintenance is prohibitively expensive. Using Telesat Lightspeed as a solution for such offshore communications, control and remote management overcomes these issues and provides scalability to these operations.

2.3 Aeronautical Usage

Given the UK prominence in the Aviation Market, with one of the largest domestic aircraft fleet and with at least one of the world's most internationally connected airport, demand for In-Flight Connectivity is expected to resume and further expand, as the Covid related market downturn finally relents. As such, the UK is a top priority country also for Telesat Lightspeed aeronautical applications. With a focus on gate-to-gate passenger experience, Telesat Lightspeed is able to offer global coverage across the entire flight path for passengers, including the Polar Regions. Passengers will be provided with a consistent in-flight fibre-like connectivity experience throughout their journey on any aeronautical route, until the arrival to their destination.

Telesat Lightspeed can also dynamically place multiple beams within hotspots, such as airports, to meet the requirements. This assures end-users with a consistent experience in the air and on the ground, always in compliance with Ofcom's and airports regulations.

Telesat Lightspeed connectivity can also offer improved operational efficiencies for airlines, allowing them to communicate with cabin crew and non-safety related systems on board the aircraft.

Telesat is collaborating with ThinKom Solutions on integrating ThinKom's Ka2517 aeronautical antennas with the Telesat Lightspeed broadband network for a complete aeronautical User Terminal solution.

Overall, Telesat Lightspeed will be the ideal solution for aviation, the most mobile of all transport sectors.

2.4 Government

Apart from land, air and sea commercial applications, Telesat is also interested in partnering with Governments around the world to support bandwidth-intensive applications, including the UK Government. Offering outstanding security, quality, global coverage and seamless mobility, Telesat Lightspeed can support governmental efforts in several areas such as defence, humanitarian aid and disaster relief efforts.

Within the defence industry, command and control is of paramount importance for coordination between ground, air and sea units as one integrated entity. The secure, high system availability, global footprint and low-latency of Telesat Lightspeed can confidently provide such wide area communications across the government's defence network for its operations domestically and internationally. Apart from operational use, Telesat Lightspeed could also be leveraged to provide cloud connectivity, and recreational-related applications as part of the welfare for duty-personnel.

For humanitarian aid and disaster relief, the quick deployment of user terminals can aid rescue efforts by easing coordination and harmonisation between disaster relief agencies and government entities in areas where communications are non-existent or unreliable. With flexible capacity and its plug-and-play nature Telesat Lightspeed allows new sites to be rapidly connected under such emergency and disaster recovery situations. This allows real-time data-intensive applications to be supported by Telesat Lightspeed, including the provision of high-resolution videos, critical to the success of such operations. In addition to providing large capacity channels to affected users, Telesat Lightspeed can also provide backhaul to restore disrupted terrestrial communications (e.g., by backhauling communications from a pico-cell or providing IP connectivity for land mobile radio and mobile phones in the affected areas).

In summary, Telesat Lightspeed is planned to be a highly integrative offering of capabilities customised to the needs of the various industries.

APPENDIX 1

Evidence in support of the reply to Question D1

1. Introduction

This Appendix provides a technical showing of the impact to existing licensees[1] due to Telesat Lightspeed, in terms of increased unavailability and of reduction in throughput. The analysis demonstrates that coexistence is possible and that the impact of the Telesat Lightspeed system into existing licensees, in terms of increased unavailability and of reduction in throughput, would be modest.

For each licensee, a dynamic interference analysis was carried out using a time-domain simulation computer program[2] to derive the Cumulative Distribution Function (CDF) of the C/N and C/(N+I) values for a victim NGSO system before and after the introduction of interference due to the Telesat Lightspeed system. These statistics were then used to determine (i) the increase in unavailability that the interference of the Telesat Lightspeed system would cause into the worst affected link of the victim NGSO system and (ii) the reduction in throughput (computed in accordance with Recommendation ITU-R S.2131-1) that the worst affected link of the victim NGSO system would experience following the introduction of interference. The manner in which the relevant simulations were set up for the uplink and downlink cases is described below.

The downlink interference was simulated from the transmitting Telesat Lightspeed satellites into the victim NGSO system receiving earth station(s). The victim NGSO system receiving earth station is located at a specified location in the UK[3] and is assumed to be collocated with a Landing Station site of the Telesat Lightspeed system. All Telesat Lightspeed satellites (up to 15) with elevation angles greater than 10 deg and with a GSO exclusion angle greater than 4.5 deg as viewed from the victim earth station were then assumed to be simultaneously radiating towards the victim earth station. The interference from these Telesat Lightspeed satellites, together with the interference caused by the antenna sidelobes of those visible satellites whose GSO exclusion angle is smaller than 4.5 deg, into this victim earth station is then computed and aggregated over time as the simulation proceeded. The aggregate interference values for each sample time were collected and those values relative to the worst impacted victim link at each sample time were considered to draw the downlink C/(N+I) statistics.

The uplink interference was simulated from the transmitting Telesat Lightspeed earth stations into the victim NGSO system receiving satellites. The victim NGSO system transmitting earth station was located at a specific location in the UK[3] and was assumed to be collocated with a Landing Station site of the Telesat Lightspeed system. All Telesat Lightspeed satellites (up to 15) with elevation angles greater than 10 deg and with a GSO exclusion angle greater than 4.5 deg as viewed from the victim NGSO system transmitting earth station were then assumed to be simultaneously pointing their beams towards the tested location. Results were obtained by aggregating the interference of all Telesat Lightspeed transmitting earth stations. All visible satellites (up to the maximum number of allowed co-frequency beams operated simultaneously towards the same location) in the other NGSO system were assumed to be pointing their receive beam towards the interfering Telesat Lightspeed

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[1] Network Access Associated Ltd, Kepler Communications Inc and Starlink Internet Services Limited (and its associated licenced NGSO gateway earth stations)

[2] Visualyse Professional (v. 7.9.10.8)

[3] Various locations in the UK have been tested and no significant variation from the results presented in this Appendix has been observed

transmitting earth stations. The interference was then aggregated from the transmitting Telesat Lightspeed earth stations into all victim uplinks in the other NGSO system. The aggregate interference values for each sample time were collected and those values relative to the worst impacted victim link at each sample time were considered to draw the uplink C/(N+I) statistics.

The Telesat Lightspeed system operates simultaneously up to 15 co-frequency beams when the satellites communicate with a Landing Station site, while the number of such beams is equal to one when the system communicates with a User Terminal. Therefore, analysing the impact of the interference caused by the Telesat Lightspeed system into a victim NGSO system by assuming the Telesat Lightspeed Landing Station site is collocated with a victim Gateway site or User Terminal, as applicable, is a conservative assumption and covers the case where a Telesat Lightspeed system User Terminal is collocated with a Gateway site or User Terminal, as applicable, of a victim NGSO system.

2. Telesat Lightspeed characteristics

Table 1 – Telesat generic parameters

Parameter	Value	Unit
Sub-constellation 1 (Polar)		
Number of planes	6	
Satellites per plane	13	
Total number of sats	78	
Orbit altitude	1015	km
Inclination	98.98	deg
Sub-constellation 2 (Inclined)		
Number of planes	20	
Satellites per plane	11	
Total number of sats	220	
Orbit altitude (km)	1325	
Inclination (deg)	50.88	
General additional parameters		
GSO exclusion angle	4.5	deg
Minimum elevation angle	10.0	deg
Total number of satellites (polar+inclined)	298	
Maximum number of beams transmitting/receiving co-frequency and simultaneously	15	-
Tracking strategy	*random*	

Table 2 – Telesat downlink parameters

Parameter	Value	Unit

Power at satellite antenna flange	*variable*[4]	
Satellite beam peak gain	30.8	dBi
Satellite antenna model	Rec. ITU-R 1528-1 (LN= -20)	
EIRP spectral density	10.5	dB(W/MHz)
Target Power Flux-Density on the ground	-131.0	dB(W/m2/MHz)
Max. sidelobe isolation for satellites within the GSO exclusion area	20.0	dB
Latitude of e/s	51.0	deg
Longitude of e/s	-4.0	deg

Table 3 – Telesat uplink parameters

Parameter	Value	Unit
e/s size	3.9	m
e/s antenna efficiency	51	%
Peak e/s antenna gain	58.2	dBi
e/s antenna pattern	Rec. ITU-R S.1428	
Power at e/s antenna flange	*variable*[5]	
Target Power Flux-Density at the satellite	-96.7	dB(W/m2/MHz)

Additional assumptions on the propagation models used in the analyses are as follows:

- **Rain attenuation:** modelled in accordance with Recommendation ITU-R P.618, considering a random p% at every time step and full correlation between wanted and interfering link

- **Attenuation by atmospheric gases and related effects:** modelled in accordance with Recommendation ITU-R P.676.

3. Compatibility analysis between Telesat Lightspeed and Network Access Associates Ltd (UK)

Table 4 – Network Access Associates Ltd (UK) generic parameters

Parameter	Value	Unit
Number of planes	18	
Satellites per plane	49	
Total number of sats	882	
Phase between planes	3.67	deg
RAAN spacing	10.15	deg
Orbit altitude	1200	km
Inclination	87.9	deg
GSO exclusion angle	6	deg
Minimum elevation	5	deg
Location of e/s	Colocated w/ Telesat's	
Maximum number of beams transmitting/receiving co-frequency and simultaneously	30	-

[4] The power at the antenna flange is varied between -30.7 dB(W/MHz) and -20.3 dB(W/MHz) in order to keep the Power Flux-Density on the ground constant depending on the slant range between the satellite receiver and the wanted earth station

[5] The power at the antenna flange is varied between -23.8 dB(W/MHz) and -13.4 dB(W/MHz) in order to keep the Power Flux-Density at the satellite constant depending on the slant range between the wanted earth station and the satellite receiver

3.1 Downlink – 19.0 GHz

Table 5 – Network Access Associates Ltd (UK) satellite parameters

Parameter	Value	Unit
Power at satellite antenna flange	*variable*[6]	
Satellite antenna size	0.35	m
Satellite antenna efficiency	60	%
Satellite peak gain	34.6	dBi
Satellite antenna model	Rec. ITU-R 1528-1 (LN= -20)	
Target Power Flux-Density on the ground	-131.8	dB(W/m2/MHz)
Tracking strategy	*random*	

[6] The power at the antenna flange is varied between -33.8 dB(W/MHz) and -24.3 dB(W/MHz) in order to keep the Power Flux-Density on the ground constant depending on the slant range between the satellite receiver and the wanted earth station

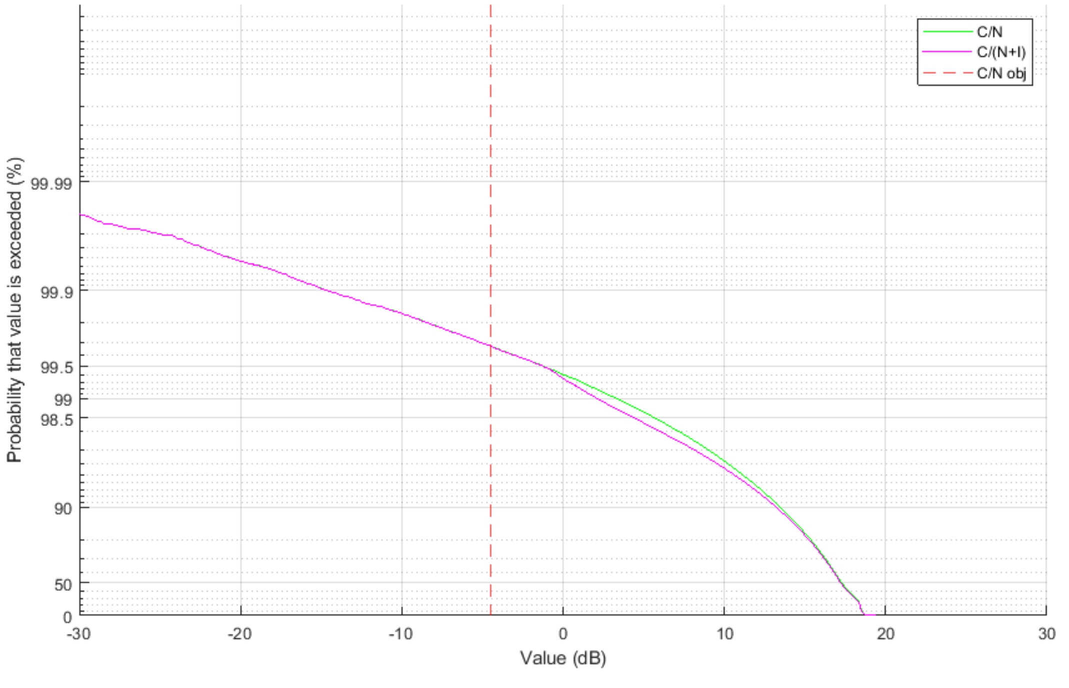
Table 6 – Network Access Associates Ltd (UK) e/s parameters

Parameter	Value	Unit
e/s size	3.5	m
e/s antenna efficiency	60	%
Peak e/s antenna gain	54.6	dBi
e/s antenna pattern	Rec. ITU-R S.1428	
Equivalent noise temperature	240	K
C/N availability objective	-4.5	dB

Table 7 – Results downlink

Parameter	Value	Unit
Increase in unavailability	0.14	%
Decrease in average spectral efficiency	0.67	%

Figure 1 – Results downlink



3.2 Uplink – 28.0 GHz

Table 8 – Network Access Associates Ltd (UK) satellite parameters

Parameter	Value	Unit
Satellite antenna size	0.35	m
Satellite antenna efficiency	60	%
Satellite peak gain	38.0	dBi
Satellite antenna model	Rec. ITU-R 1528-1 (LN= -20)	
Target Power Flux-Density at the satellite	-100.8	dB(W/m2/MHz)
Equivalent noise temperature	440	K
Tracking strategy	*random*	
C/N availability objective	-4.5	dB

Table 9 – Network Access Associates Ltd (UK) e/s parameters

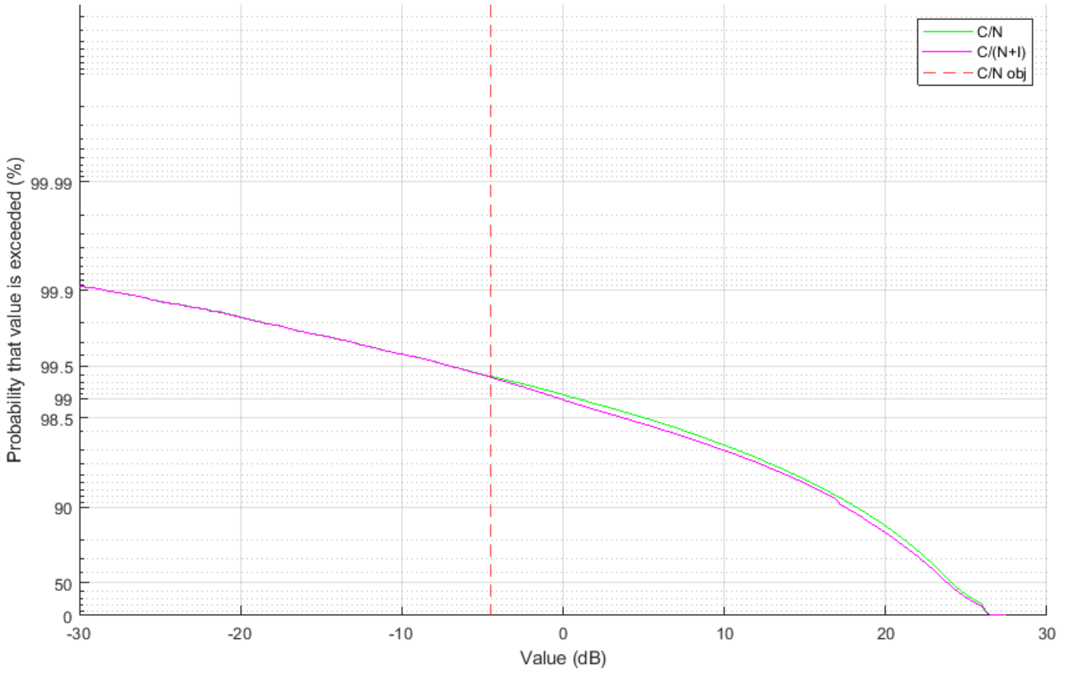
Parameter	Value	Unit
e/s size	3.5	m
e/s antenna efficiency	60	%
Peak e/s antenna gain	58.0	dBi
e/s antenna pattern	Rec. ITU-R S.1428	
Power at e/s antenna flange	*variable*[7]	

Table 10 – Results uplink

Parameter	Value	Unit
Increase in unavailability	1.94	%
Decrease in average spectral efficiency	1.34	%

[7] The power at the antenna flange is varied between -26.2 dB(W/MHz) and -16.8 dB(W/MHz) in order to keep the Power Flux-Density at the satellite constant depending on the slant range between the wanted earth station and the satellite receiver

Figure 2 – Results uplink



4. Compatibility analysis between Telesat Lightspeed and STARLINK INTERNET SERVICES LIMITED

Table 11 – STARLINK INTERNET SERVICES LIMITED generic parameters

Parameter	**Value**	**Unit**
Sub-constellation 1		
Number of planes	72	
Satellites per plane	22	
Total number of sats	1584	
Orbit altitude	550	km
Inclination	53.0	deg
Sub-constellation 2		
Number of planes	72	
Satellites per plane	22	
Total number of sats	1584	
Orbit altitude (km)	540	
Inclination (deg)	53.2	
Sub-constellation 3		
Number of planes	36	
Satellites per plane	20	

Total number of sats	720	
Orbit altitude (km)	570	
Inclination (deg)	70.0	
Sub-constellation 4		
Number of planes	10	
Satellites per plane	52	
Total number of sats	520	
Orbit altitude (km)	560	
Inclination (deg)	97.6	
General additional parameters		
GSO exclusion angle	18	deg
Minimum elevation angle	25	deg
Total number of satellites (polar+inclined)	4408	
Maximum number of beams transmitting/receiving co-frequency and simultaneously	8	-
Tracking strategy	*random*	

4.1 Downlink – 19.0 GHz

Table 12 – STARLINK INTERNET SERVICES LIMITED satellite parameters

Parameter	Value	Unit
Power at satellite antenna flange	*variable*[8]	
Satellite antenna size	0.35	m
Satellite antenna efficiency	58	%
Satellite peak gain	34.5	dBi
Satellite antenna model	Rec. ITU-R 1528-1 (LN= -20)	
Target Power Flux-Density on the ground	-126.3	dB(W/m2/MHz)
Tracking strategy	*random*	

[8] The power at the antenna flange is varied between -35.2 dB(W/MHz) and -28.5 dB(W/MHz) in order to keep the Power Flux-Density on the ground constant depending on the slant range between the satellite receiver and the wanted earth station

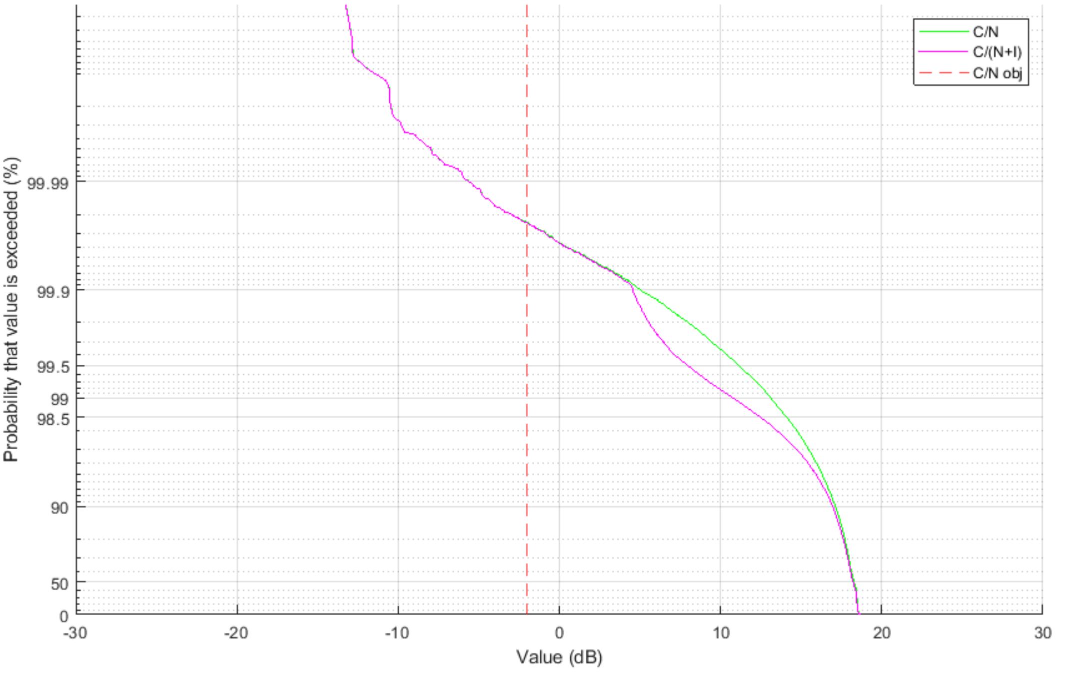
Table 13 – STARLINK INTERNET SERVICES LIMITED e/s parameters

Parameter	Value	Unit
e/s size	1.47	m
e/s antenna efficiency	65	%
Peak e/s antenna gain	47.5	dBi
e/s antenna pattern	Rec. ITU-R S.1428	
Equivalent noise temperature	240	K
C/N availability objective	-2.0	dB

Table 14 – Results downlink

Parameter	Value	Unit
Increase in unavailability	1.98	%
Decrease in average spectral efficiency	0.70	%

Figure 3 – Results downlink



4.2 Uplink – 28.0 GHz

Table 15 – STARLINK INTERNET SERVICES LIMITED satellite parameters

Parameter	Value	Unit
Satellite antenna size	0.37	m
Satellite antenna efficiency	60	%
Satellite peak gain	38.5	dBi
Satellite antenna model	Rec. ITU-R 1528-1 (LN= -20)	
Equivalent noise temperature	501.2	K
Tracking strategy	*random*	
Avoidance angle employed by Telesat e/s	1.0	deg
C/N availability objective	-4.5	dB

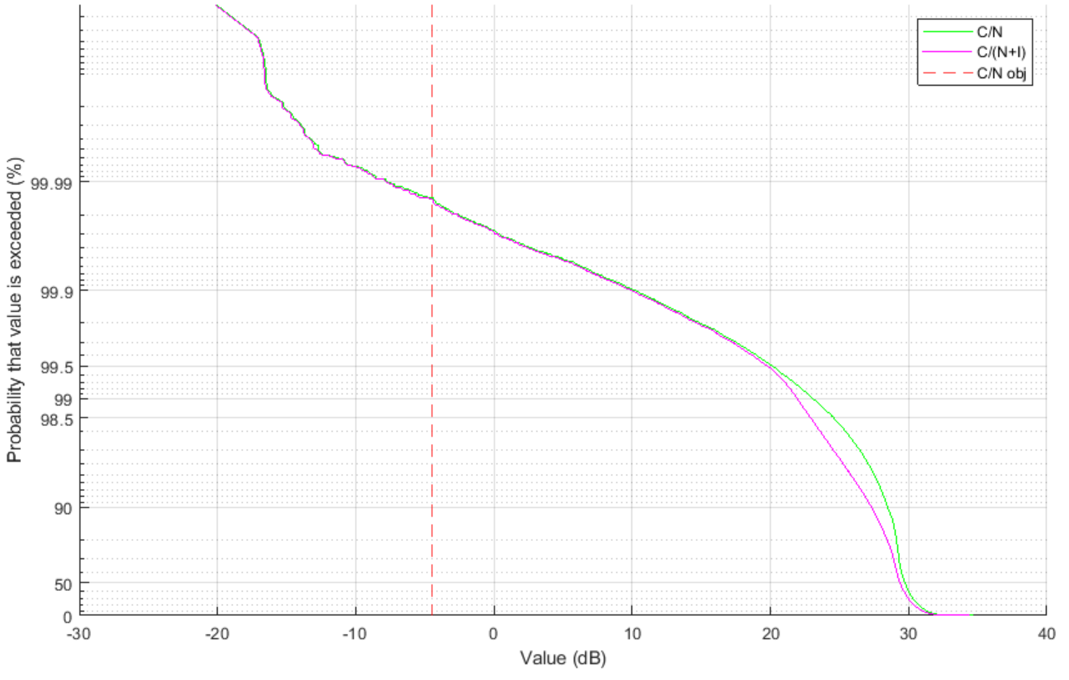
Table 16 – STARLINK INTERNET SERVICES LIMITED e/s parameters

Parameter	Value	Unit
e/s size	1.47	m
e/s antenna efficiency	65	%
Peak e/s antenna gain	50.8	dBi
e/s antenna pattern	Rec. ITU-R S.1428	
Power at e/s antenna flange	-18.8	dB(W/MHz)

Table 17 – Results uplink

Parameter	Value	Unit
Increase in unavailability	1.67	%
Decrease in average spectral efficiency	0.14	%

Figure 18 – Results uplink



5. Compatibility analysis between Telesat Lightspeed and Kepler Communications Inc.

Table 18 – Kepler Communications Inc. generic parameters

Parameter	**Value**	**Unit**
Number of planes	12	
Satellites per plane	30	
Total number of sats	360	
Orbit altitude	650	km
Inclination	89.5	deg
GSO exclusion angle	11.5	deg
Minimum elevation	38.8	deg
Location of e/s	Colocated w/ Telesat's	
Maximum number of beams transmitting/receiving co-frequency and simultaneously	1	-

5.1 Downlink – 19.0 GHz

Table 19 – Kepler Communications Inc. satellite parameters

Parameter	Value	Unit
Power density at the antenna flange	-68	dB(W/Hz)
Satellite peak gain	27	dBi
Satellite antenna model	Rec. ITU-R 1528-1 (LN= -20)	
EIRP spectral density	-41	dB(W/Hz)
Tracking strategy	*random*	

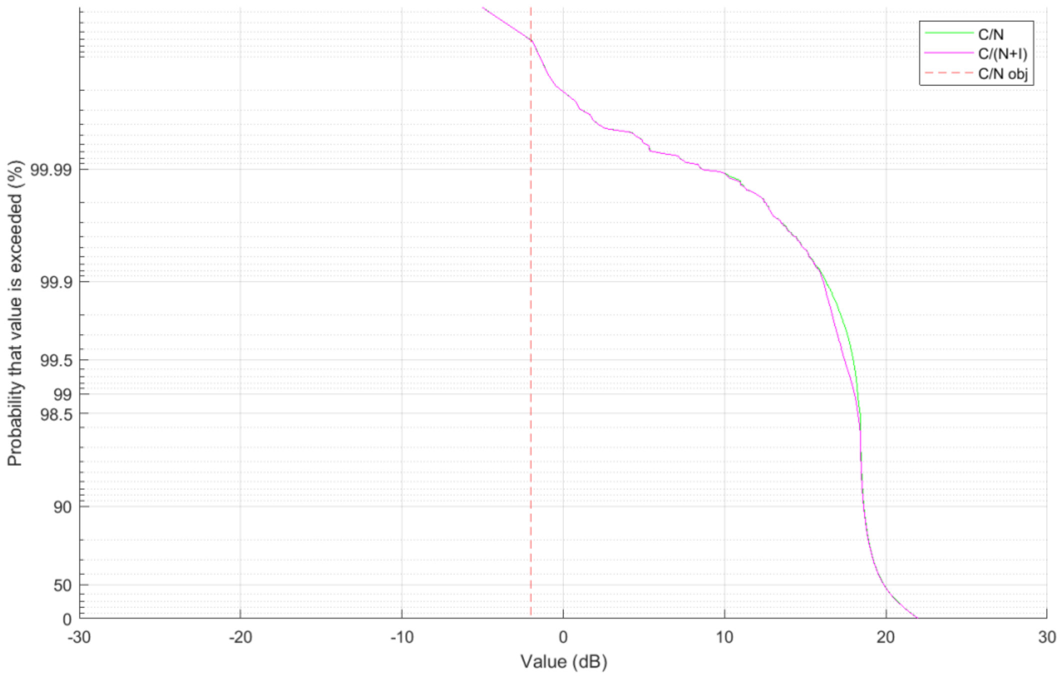
Table 20 – Kepler Communications Inc. e/s parameters

Parameter	Value	Unit
e/s size	0.3	m
e/s antenna efficiency	65	%
Peak e/s antenna gain	33.8	dBi
e/s antenna pattern	Rec. ITU-R S.580	
Equivalent noise temperature	300	K
C/N availability objective	-2.0	dB

Table 21 – Results downlink

Parameter	Value	Unit
Increase in unavailability	0.00	%
Decrease in average spectral efficiency	0.11	%

Figure 19 – Results downlink



5.2 Uplink – 28.0 GHz

Table 22 – Kepler Communications Inc. satellite parameters

Parameter	**Value**	**Unit**
Satellite peak gain	15.0	dBi
Satellite antenna model	Rec. ITU-R 1528-1 (LN= -20)	
Equivalent noise temperature	955	K
Tracking strategy	*random*	
C/N availability objective	-2.0	dB

Table 23 – Kepler Communications Inc. e/s parameters

Parameter	**Value**	**Unit**
e/s size	0.3	m
e/s antenna efficiency	70	%
Peak e/s antenna gain	37.4	dBi
e/s antenna pattern	Rec. ITU-R S.1428	
Power at e/s antenna flange	0.0	dB(W/MHz)

Table 24 – Results uplink

Parameter	Value	Unit
Increase in unavailability	0	%
Decrease in average spectral efficiency	0.01	%

Figure 20 – Results uplink