

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of)
)
Telesat Canada) FCC File No. SAT-_____)
)
Application to Modify Petition for)
Declaratory Ruling to Grant Access to)
the U.S. Market for Telesat's NGSO)
Constellation)

**APPLICATION FOR MODIFICATION OF
MARKET ACCESS AUTHORIZATION**

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On November 15, 2016, in response to the first Ku/Ka processing round¹, Telesat filed a Petition for Declaratory Ruling² (hereafter the “Petition”) seeking U.S. market access for a Canadian-licensed non-geostationary satellite orbit (“NGSO”) constellation of 117 satellites in low-earth-orbit (“LEO”) (hereafter the “Constellation”). The Constellation includes 72 satellites in polar orbit and 45 satellites in inclined orbit, plus spares, which provide global coverage and high throughput broadband capacity on a robust, flexible, and cost-effective basis.³

¹ See Public Notice, OneWeb Petition Accepted for Filing, DA 16-804, File No. SAT-LOI-20160428-00041 (July 15, 2016).

² Telesat Canada Petition for Declaratory Ruling to Grant Access to the U.S. Market for Telesat's NGSO Constellation, IBFS File No. SAT-PDR-20161115-00108.

³ The Telesat petition described a constellation consisting of 117 satellites in 11 orbital planes, with 6 planes (12 satellites per plane) inclined 99.5 degrees in a circular orbit at an approximate altitude of 1000 kilometers and 5 planes (9 satellites per plane) inclined 37.4 degrees in a circular orbit at an approximate altitude of 1248 kilometers. The petition proposed that the satellites operate in the 17.8-18.6 GHz (space-to Earth), 18.8-19.3 GHz (space-to-Earth), 19.7-20.2 GHz (space-to-Earth), 27.5-29.1 GHz (Earth-to-space), and 29.5-30.0 GHz (Earth-to-space) frequency bands.

On November 3, 2017, the Commission granted the Petition (hereafter the “Grant”), finding that its proposed Constellation would advance the Commission’s mandate “to make available, so far as possible, to all the people of the United States . . . rapid, efficient, Nation-wide, and world-wide” communication services and that Telesat’s system would enhance competition among existing and future FSS satellite systems.

Telesat now seeks to modify the Grant with a revised design that adds satellites to both the polar and inclined orbits, thereby enhancing system performance, and changes the satellites’ inclination and altitude, thereby optimizing orbital parameters. These modifications not only will serve the public interest by improving coverage, system resilience, and capacity, but will also offer more signal routing choice among active satellites to provide connectivity to end users and landing stations. This increase in signal routing choice not only improves system performance and reliability, but also improves the Constellation’s ability to co-exist with other NGSO constellations.

In the first phase of its plan, Telesat will add 181 satellites to its Constellation, bringing the total in Phase 1 to 298 satellites (the “Modified Constellation”). In the second phase of its plan, Telesat will add 1373 satellites, bringing the total at the end of Phase 2 to 1671 satellites (the “Final Constellation”).

Following discussions with the staff of the International Bureau, Telesat is filing this single application covering both phases and addressing the distinct regulatory implications of each phase. The Phase 1 modification is intended for regulatory review

and processing in the first processing round because, as will be established herein, a variety of offsetting factors ensure that other participants in the first Ka-band processing round will be protected from interference at least to the same extent as they were prior to the Phase 1 modification. As demonstrated in the Technical Exhibit, operating with the Modified Constellation reduces the probability that, even absent coordination, band segmentation would be required.

The Phase 2 modification is intended for regulatory review and processing in the second processing round.⁴ Because the Commission has not yet determined the relative interference protection criteria for first and second round applicants, Telesat is not providing an interference analysis to support addition of 1373 satellites but will accept for those satellites whatever coordination and sharing requirements the Commission establishes for second round applicants.

The Commission's IBFS filing system will accommodate only a single Schedule S with a modification filing. Accordingly, the Schedule S Telesat is providing with this filing makes a showing for the Final Constellation. Telesat, however, was able to generate in IBFS a Schedule S for the 298 satellites in its Modified Constellation that bears the heading "DRAFT COPY - Not for submission" and is providing this version of

⁴ Public Notice, Satellite Policy Branch Information Cut-Off Established for Additional NGSO FSS Applications or Petitions for Operations in the 10.7-12.7 GHz, 12.75-13.25 GHz, 13.8-14.5 GHz, 17.7-18.6 GHz, 18.8-20.2 GHz, And 27.5-30 GHz Bands, DA 20-325 (rel. Mar 24, 2020).

Schedule S as an attachment. To the extent Telesat requires a waiver of Section 25.114 of the rules⁵ to proceed in this fashion, it is hereby requested.

I. PROGRESS TO DATE

Since submitting the Petition in 2016, Telesat has engaged in a rigorous process of detailed design and risk management to improve upon the design of the Constellation including working with satellite manufacturers, developers and manufacturers of essential components and subsystems, and launch providers.

The dialog produced by Telesat's interaction with these groups, as well as the expertise of Telesat's own highly experienced technical team, have led to the evolution and refinement of the design and technical characteristics of its both its Modified Constellation and its Final Constellation.

The Modified Constellation provides a powerful, efficiently-designed NGSO LEO network that will achieve flexible global high-speed broadband coverage using a fraction of the number of satellites proposed for some other constellations. The Final Constellation offers a modular growth path to address future demand.

Examples of Telesat's progress to date are summarized below and have hastened the day when Telesat will implement its Modified Constellation and then its Final Constellation and provide the many public interest benefits that the Commission

⁵ 47 C.F.R. § 25.114.

foresaw when it approved Telesat's proposal, as extended and enhanced by the improvements identified in this filing.

A. LEO-1 launched and operational

Telesat's first LEO satellite ("LEO-1") in its Constellation was launched in January, 2018, into one of the orbits approved by the FCC and licensed in Canada by Innovation, Science and Economic Development Canada (ISED). It is now supporting live demonstrations across a variety of markets and applications. A second LEO satellite suffered a launch failure.

Live tests and demonstrations using LEO-1 allow Telesat customers and LEO hardware vendors to experience low-latency, high throughput performance, satellite tracking and Doppler compensation. Recent LEO-1 demonstrations include applicability for a public safety broadband network, 5G mobile network backhaul, connectivity to transportable antenna systems, including antennas in aircraft, and advanced antenna technology for the U.S. Navy.

B. U.S. Government

Telesat is receiving funding from the U.S. Government to develop applications of the Constellation for U.S. national security space systems, including working with the Department of Defense on future national security space architectures for "Proliferated LEO" systems, which would offer high-throughput communications to support military missions, eliminate reliance on terrestrial infrastructure to relay data from around the world, and provide a space-based "WiFi network" that can be used to connect multiple

constellations of satellites performing a wide variety of critical functions. At present, Telesat is performing work on contracts with U.S. Government customers including DARPA and U.S. Space Force/SMC.

C. Government of Canada

Today approximately 2.2 Million households in Canada lack access to high-speed Internet, including many rural areas and First Nation communities. Accordingly, the Government of Canada and Telesat signed a Memorandum of Understanding to provide a non-repayable contribution of C\$600M to Telesat over ten years to provide a significantly subsidized pool of capacity to ISPs across Canada to deliver universal connectivity. In addition, the Government of Canada committed to provide an additional C\$85M to Telesat in support of the R&D efforts associated with Telesat's Constellation.

D. Space Segment

Telesat has been in detailed discussions with two satellite prime contractors and has entered into schedule protection contracts with them and with several subcontractors for key technology elements. This effort has served to advance the system and satellite designs significantly and to reduce risk on key technologies. In the next few months, the supply chain will be finalized for all critical elements and procurement of long lead items will begin. Barring complications resulting from the Covid-19 pandemic, Telesat's goal is to be in the position to execute a final contract for the satellites early in the second half of 2020.

E. Launch services

Telesat has been in discussions with multiple launch service providers for the deployment of its Constellation and already has agreements in place with Blue Origin and Relativity. Telesat expects to conclude additional launch service agreements in 2020.

F. Ground segment

Telesat has issued a request to multiple vendors for proposals for earth station antennas and RF ground equipment and is currently in the process of evaluating their responses. Telesat expects to make a selection and contract award this summer.

II. PUBLIC INTEREST BENEFITS OF TELESAT'S MODIFIED AND FINAL CONSTELLATIONS

A. Overall Design

The overall concept for the Telesat LEO constellation remains generally unchanged. The Modified and Final Constellations still feature:

- An integrated system capable of providing layer-2 Carrier Ethernet connectivity with highly secure and resilient low-latency links, invoking flexible satellite and network technologies to provide power and spectrum where and when needed;

- A unique hybrid constellation concept that comprises polar orbits to ensure global coverage and inclined orbits concentrating satellites over equatorial and mid-latitude areas where demand is concentrated;
- Ka-band frequencies for both User links and Feeder links connecting Landing Stations;
- Satellites with onboard processing and optical inter-satellite links;
- Satellites equipped with four steerable spot beams to communicate with the Landing Stations, and a set of Direct Radiating Array (DRA) antennas providing up to 24 fully independent, shapeable and steerable beams for User links; and
- An integrated Constellation Network Operating System (CNOS) to allocate resources (power, bandwidth, beam size etc.) through the entire network.

B. Comparison of original design to proposed modifications

The table below compares the relevant characteristics of the Constellation, the Modified Constellation, and the Final Constellation:

Parameter		Telesat Grant	Modified Constellation	Final Constellation
Polar Sub-constellation	Orbital planes	6	6	27
	Satellites per plane	12	13	13
	Inclination (deg)	99.5	98.98	98.98
	Altitude (km)	1000	1015	1015
	Total satellites	72	78	351
Inclined Sub-constellation	Orbital planes	5	20	40
	Satellites per plane	9	11	33
	Inclination (deg)	37.4	50.88	50.88
	Altitude (km)	1248	1325	1325
	Total satellites	45	220	1320
Total satellites in constellation		117	298	1671

C. Specific Public Interest Benefits

Telesat’s Modified and Final Constellations will deliver Gbps downlink speeds anywhere on earth and will allow a much more affordable and ubiquitous provision of broadband services across the United States. The additional 181 satellites in the Modified Constellation and 1373 more satellites above that in the Final Constellation mean more satellites in view of a given user or gateway, which:

- Provides choice to address weather, performance issues, and failures, and helps mitigate interference and facilitate coordination.
- Provides better service and better continuity of service.
- Fosters an interference environment that facilitates coexistence among multiple constellations, as shown below and in the Technical Exhibit.
- As demonstrated in the Technical Exhibit, operating with the Modified Constellation reduces the probability that, even absent coordination, band segmentation would be required.
- Facilitates launches - taking advantage of polar launch maximum of 13 satellites optimizes launch resource and at the same time incorporates additional satellites better to ensure service continuity in the event of failures.
- Distributes available capacity more closely with the expected demand through all geographic areas. The previous design had a lower percentage of the overall constellation of satellites in inclined orbit, but the new design augments the number of inclined satellites, increasing the percentage of satellites in the inclined orbit, which are more focused on the low to mid latitudes which are the areas where most people live and travel .
- Improves capability of delivering 5G backhaul anywhere in the world.
- Improves viability of Optical Inter-Satellite Links (“OISL”), which is very important for government customers. U.S. DoD, for example, is focussed on OISL interconnect as an essential part of any Proliferated-LEO architecture.

- Enhances rural broadband capabilities to meet connectivity needs, including more affordable delivery of capacity to ISPs, which in turn can extend their networks to more rural areas and provide more affordable rates to consumers.
- Uses available spectrum more efficiently in that Telesat’s advanced design employs frequency reuse allowing efficient spectrum utilization that translates to higher capacity, lower cost and improved affordability of services, hence improving public benefits.

III. NARRATIVE SUMMARY OF THE INTERFERENCE SHOWING FOR THE MODIFIED CONSTELLATION

A. Legal framework

The International Bureau has addressed explicitly the legal framework for evaluating modifications to licenses and U.S. market access grants for NGSO FSS systems.⁶ Based on the legal framework, Telesat’s Phase 1 modification should be considered part of the initial processing round for NGSO FSS Ka-band systems.

The Bureau has held that Section 25.117 of the rules⁷ governs applications to modify NGSO FSS space station authorizations granted in a processing round.⁸ Section

⁶ See *Request for Modification of the Authorization for the SpaceX NGSO Satellite System*, Order and Authorizations, 34 FCC Rcd 2526 (IB 2019) (“SpaceX Grant”).

⁷ 47 C.F.R. § 25.117.

⁸ SpaceX Grant, ¶¶ 6-7.

25.117(d)(2) provides that unless one of two potentially relevant exceptions applies, applications for modifications of space station authorizations “will be granted.”⁹

The first exception concerns “[a]pplications for modifications of space station authorizations to increase the authorized bandwidth.”¹⁰ That exception is inapplicable here; Telesat seeks no changes to frequencies or authorized bandwidth.

The second exception applies if “[g]ranted the modification request would not serve the public interest, convenience, and necessity.”¹¹ Under this standard, the Bureau has stated, “[i]f a modification would worsen the interference environment, that would be a strong indication that grant of the modification would not be in the public interest.”¹²

The Bureau applied the “worsen the interference environment” test to a modification application SpaceX filed in November 2018.¹³ The Bureau concluded, based in part on there being “no increase in the number of satellites in the SpaceX constellation,” that “the number of spatial configurations that have the potential for generating interference between SpaceX and any other NGSO FSS system in the same

⁹ 47 C.F.R. § 25.117(d)(2).

¹⁰ 47 C.F.R. § 25.117(d)(2)(iv).

¹¹ 47 C.F.R. § 25.117(d)(2)(ii).

¹² SpaceX Grant, ¶ 9.

¹³ See SpaceX Grant, ¶¶ 10-11.

processing round” was “expected to remain approximately unchanged.”¹⁴ The Bureau, therefore, granted SpaceX’s application.¹⁵

There also is precedent for granting an NGSO FSS modification application that increases the number of satellites, but not initiating a new processing round, so long as there is no change in the interference environment. That is precisely what the Bureau did in granting an application filed by O3b that added four satellites to O3b’s constellation.¹⁶ O3b had shown that expanding its fleet would provide additional satellite diversity, thereby enhancing sharing capabilities.¹⁷

Telesat demonstrates herein that its Modified Constellation does not “worsen the interference environment.” Accordingly, under the test the Bureau established in the SpaceX Grant, Telesat’s Phase 1 modification application should be deemed consistent with the public interest and, based on Section 25.117(d)(2), the Phase 1 modification application should be granted as part of the first processing round.

As stated above, Telesat is not providing an interference showing for the Final Constellation because the Commission has not yet determined the relative interference protection criteria for first and second round applicants, but will accept for the

¹⁴ SpaceX Grant, ¶ 11.

¹⁵ See SpaceX Grant.

¹⁶ See grant stamp, O3b Limited, File Nos. SAT-LOI-20141029-00118 and SAT-AMD-20150115-00004 (Jan. 22, 2015).

¹⁷ See O3b Limited’s Petition for Declaratory Ruling, File Nos. SAT-LOI-20141029-00118 and SAT-AMD-20150115-00004, Attachment A at 29-31.

additional 1373 satellites in the Final Constellation whatever coordination and sharing requirements the Commission establishes for second round applicants.

B. Technical Analysis

As discussed in the attached Technical Exhibit, Telesat has carried out an extensive analysis to demonstrate that its Modified Constellation does not adversely impact the interference environment for Telesat's NGSO system or other NGSO systems and does not impose any additional requirement on them for spectrum splitting. In reaching these conclusions, Telesat analyzed the four possible interference scenarios in which its Modified Constellation co-exists with other NGSO systems: when the Telesat system is either the victim or the interferer, in each of the uplink and downlink directions. Since there are more satellites available in the Modified Constellation, there will be additional opportunities to use satellite diversity and select links that cause or receive less interference. Other operational and design link parameters also contribute to ensure the Modified Constellation will not adversely affect the interference environment of other NGSO systems.

C. EPFD Waiver

Although not required by the Commission's rules, Telesat has provided an analysis in the Technical Exhibit to demonstrate that its Modified Constellation will continue to comply with the applicable EPFD limits in the Ka-band. Taking into account the significant backlog currently experienced by the ITU Radiocommunication Bureau ("ITU BR") in assessing the compliance of NGSO systems with the applicable EPFD

limits, it may be the case that the Modified Constellation will commence operations *before* the ITU BR has carried out its assessment. Therefore, out of an abundance of caution, and taking into account the analysis shown in the Technical Exhibit, Telesat seeks a waiver to be able to commence operations before receiving a favorable or “qualified favorable” finding from the ITU BR with respect to the compliance of the Modified Constellation with the applicable limits set forth in Article 22 of the ITU Radio Regulations.

In contrast, Telesat has not done a comparable EPFD analysis to demonstrate that its Final Constellation will comply with the applicable EPFD limits in the Ka-band and is not seeking a waiver as to operation of the Final Constellation. Rather, Telesat will inform the Commission when it has received a favorable or qualified favorable finding from the ITU BR as to its Final Constellation, which Telesat anticipates will be before the additional satellites in the Final Constellation commence operation.

IV. TELESAT’S MODIFIED AND FINAL CONSTELLATIONS SATISFY THE COMMISSION’S REQUIREMENTS FOR SERVING THE UNITED STATES

The Commission has an established framework for considering requests for non-U.S. licensed space stations to access the U.S. market. In evaluating requests for such authority, the Commission considers the effect on competition in the United States, spectrum availability, eligibility and operational requirements, and concerns related to

national security, law enforcement, foreign policy, and trade.¹⁸ Telesat's Constellation application satisfied all of these tests, as confirmed by the Grant. Telesat's Modified and Final Constellations, as described in detail in this application, continue to satisfy these tests.

A. Legal and Technical Qualifications

The information set forth in this application establishes that the proposed operation of the Modified and Final Constellations are consistent with the Commission's legal and technical requirements, including those specified in Section 25.114 of the Commission's rules. In addition, Telesat makes specific note below of its compliance with other applicable parts of the Commission's Rules.

1. Prohibition on Exclusive Arrangements

Telesat hereby reaffirms its compliance with Section 25.145(e) of the Commission's rules in that neither it nor any person or company controlling or

¹⁸ See *Amendment of the Commission's Regulatory Policies to Allow Non-U.S. Licensed Space Stations to Provide Domestic and International Satellite Service in the United States*, 12 FCC Rcd 24094, ¶ 29 (1997) ("DISCO II Order"), on reconsideration, 15 FCC Rcd 7207, ¶ 5 (1999). See also Section 25.137 of the Commission rules, 47 C.F.R. § 25.137.

controlled by Telesat has or shall acquire or enjoy any exclusive right to provide service in or to or from the United States.

2. Milestones

Pursuant to Sections 25.137(d)(1) and 25.164(b) of the Commission's rules, recipients of U.S. market access grants are subject to Commission rules that require NGSO system licensees to launch and operate their NGSO constellations in accordance with milestone requirements. Telesat will demonstrate compliance with this FCC requirement by making a showing under Section 25.164(f) as and when required

3. Posting of Bond

Pursuant to Sections 25.137(d)(4) and 25.165(a) of the Commission's rules, recipients of U.S. market access grants for non-U.S. licensed NGSO systems are subject to a modified, escalating post-grant bond requirement. Following the Grant, Telesat posted the required initial bond amount of \$1 million. Telesat has increased and will continue to increase the bond amount in order to comply with the Commission's escalating bond requirements.¹⁹

4. Mitigation of Orbital Debris

Section 25.114(d) (14) of the Commission's rules requires applicants for space station licenses to provide a description of the design and operational strategies that

¹⁹ See Public Notice, International Bureau Updates Procedures for Filing and Maintaining Surety Bonds Pursuant to Revised Milestone and Escalating Bond Requirements, DA 16-1157 Report No. SPB-266 (Oct. 7, 2016).

will be used to mitigate orbital debris.²⁰ With respect to the Constellation, the Grant is conditioned as follows:

“Upon finalization of its space station design and prior to initiation of service, Telesat must seek and obtain the Commission’s approval of a modification specifying additional details regarding risk of collision and its end-of-life operations ...”.²¹

Telesat will abide by that condition as applied to the Modified and Final Constellations.

In addition, the Commission can be assured that Telesat presently is coordinating with other NGSO LEO constellation operators to avoid physical collision of satellites and that Telesat has and will continue to design its Modified and Final Constellations, and to operate them when deployed, to comply with the Commission’s Rules to avoid collisions in space and minimize orbital debris.

B. Other Public Interest Factors

In the Grant, the Commission found that Telesat’s provision of service in the United States using its Constellation will enhance competition without limiting spectrum availability, and raises no national security, law enforcement, foreign policy, or trade concerns. A grant of this application will be consistent with these findings.

²⁰ For non-U.S.-licensed space stations, this requirement can be satisfied by demonstrating that debris mitigation plans are subject to direct and effective regulatory oversight by the national licensing authority. Telesat is subject to the direct regulatory oversight of its Canadian licensing authority, Innovation, Science and Economic Development Canada (“ISED”), with regard to issues of orbital debris mitigation plans for the satellites that will comprise the Modified and Final Constellations.

²¹ Grant at ¶29d.

C. Waiver Requests

Telesat's application to modify its Grant requires no waivers other than the EPFD waiver and the waiver of Schedule S requirements requested above and continuation of the waivers already granted by the Commission with regard to its Constellation.