

April 18, 2017

The Director General  
Engineering, Planning and Standards Branch  
Innovation, Science and Economic Development Canada  
6<sup>th</sup> Floor  
235 Queen Street  
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**Re: Consultation on the Licensing Framework for Non-Geostationary Satellite Orbit (NGSO) Systems and Clarification of Application Procedures for All Satellite License Applications (SMSE-009-17)**

Dear Mr. Proulx,

Space Exploration Technologies Corp. ("SpaceX") hereby comments on the Consultation on the Licensing Framework for Non-Geostationary Satellite Orbit (NGSO) Systems and Clarification of Application Procedures for All Satellite License Applications ("Consultation") as published in the *Canada Gazette*, Part I, Vol. 151, No. 9 on March 4, 2017.

Innovation, Science and Economic Development Canada ("ISED") is one of the first national administrations to address critical questions of appropriate license terms and rules for large and mega NGSO constellations. By virtue of its position as an early mover, ISED invariably will be viewed as a model by counterpart agencies in other countries addressing the licensing of NGSO systems. To this end, SpaceX welcomes the opportunity to provide input on Canada's NGSO licensing framework and assist ISED in developing a world-class NGSO licensing regime.

In this proceeding, ISED has proposed changes to the licensing rules for NGSO systems and certain clarification of the procedures for re-assigning spectrum when authorizations have been returned or revoked. SpaceX supports ISED's efforts to update and clarify its rules to facilitate the deployment of NGSO FSS systems and enable greater operational flexibility. SpaceX recently applied to the U.S. Federal Communications Commission ("FCC") for authority to operate a large NGSO constellation of fixed satellite service ("FSS") satellites. Those filings gave rise to several observations regarding the rules governing NGSO system licensing generally, which are germane to the licensing issues currently under review in Canada.

The contemporary NGSO FSS industry is dynamic, featuring multiple new players and business models aiming to rapidly develop improved technologies and demonstrate the ability to provide communications services in Canada and around the globe. ISED's licensing approach should encourage innovative NGSO constellation designs and operational strategies. Likewise, the rules should promote good spectrum stewardship so that multiple NGSO, geostationary orbit ("GSO"), and terrestrial systems can share spectrum resources while delivering services to the public. The challenge facing regulatory agencies is determining how best to craft rules that are appropriate for NGSO constellations ranging from dozens of satellites to several thousand satellites phased in over time in various spectrum bands. Overall, the licensing system and related rules should create both opportunities and strong incentives for deployment of advanced and capable systems that feature the operational flexibility and technical agility needed to operate in an environment with multiple systems in the same spectrum bands.

### **General comments**

Under its current business plan, SpaceX intends to operate as a foreign licensed satellite system in Canada. As such, we have considered the items raised in this Consultation from this perspective. We also note that, with the exception of the issues raised in Question I of the consultation, the revised Procedures expressly apply to space stations (satellites) licensed in Canada, as opposed to foreign-licensed satellites and systems that seek approval to operate in Canada and which are subject to the Procedure for the Submission of Applications to License Fixed Earth Stations and to Approve the Use of Foreign Satellites in Canada (CPC 2-6-01).<sup>1</sup>

SpaceX's comments will address each of the specific Consultation questions in turn.

#### **A. ISED seeks views on the following:**

- 1. Whether to impose a limit on the number of licenses issued per band for commercial systems;**
- 2. If so, what would be an appropriate limit; and**
- 3. If a limit is imposed, whether to exclude systems whose purpose is data gathering and that transmit to a small number of fixed earth stations and non-commercial systems (i.e. academic, government and developmental) from this limit.**

SpaceX advises ISED against imposing a limit on the number of licenses issued. Instead, SpaceX recommends that ISED focus on ensuring that all operators strive for maximum interoperability and spectral efficiency. NGSO system operators must share spectrum with GSO and terrestrial systems, and must protect operations in nearby spectrum for services such as Radio Astronomy. The ability to share available spectrum in an efficient

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<sup>1</sup> CPC-2-6-01 — Procedure for the Submission of Applications to License Fixed Earth Stations and to Approve the Use of Foreign Satellites in Canada.

manner will be a crucial prerequisite to enabling NGSO FSS systems to optimize broadband speeds and increase broadband availability for customers in Canada and around the world. As such, efficient spectrum usage and sharing is an important objective in line with the Policy Framework for Fixed-Satellite Service (FSS) and Broadcasting-Satellite Service (BSS) (“the Policy”), helping to ensure that Canadian satellite users have access to the satellite capacity that they need in order to carry out their respective functions and helping to ensure that services are available throughout Canada.<sup>2</sup>

Fortunately, many of the technological advances being incorporated into NGSO system designs create operational flexibility that can facilitate spectrum coordination. For example, phased array antennas and adaptive beam-forming strategies allow satellites to target narrow coverage areas more precisely while enabling earth stations to track satellites moving through the sky and then seamlessly transition to the next one appearing over the service horizon. More powerful computing and software capabilities enable operators to allocate resources in real time, so that capacity can be placed where it is most needed and energy can be directed away from areas where it might cause interference to other spectrum users. A system design that allows a customer to be served by more than one satellite at a time (a concept called “satellite diversity”) enables the operator to determine which specific satellite to use based on whether it would cause or receive interference from a satellite of another system.<sup>3</sup> NGSO systems with these sorts of on-orbit flexibility present more options for potential spectrum sharing strategies than do less advanced systems whose operational capabilities are more constrained, and regulations should promote these systems for the ultimate benefit of the consumer.

There is considerable value in developing a regulatory regime that creates incentives for NGSO operators to design their systems with a range of advanced capabilities that facilitate spectrum sharing and improved coordination. As NGSO technology continues to evolve and improve, increased capability for spectrum efficiency, sharing, and interoperability may increase the feasible number of NGSO satellites or systems over time. A flexible licensing regime that creates strong incentives for technological improvements will benefit NGSO operators and Canadian users through more efficient use of spectrum resources and improved service and coverage options.

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<sup>2</sup> See *RP-008 — Policy Framework for Fixed-Satellite Service (FSS) and Broadcasting-Satellite Service (BSS)*, Section 2.

<sup>3</sup> As explained by the United States Federal Communication Commission (“FCC”), “[w]ith satellite diversity, NGSO FSS systems can avoid an in-line interference event by selecting another visible satellite within their system constellation (performing a hand-over process) whenever the current satellite approaches the in-line event with a satellite operating in another NGSO FSS system constellation.” See *Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ka-Band*, 18 FCC Rcd. 14708, ¶ 44 (2003).

Efficient spectrum sharing will be essential to the success of all NGSO FSS systems. ISED's rules should reward those systems that facilitate such sharing, as they benefit all NGSO FSS operators and enable them to make more efficient use of valuable spectrum resources.

**B. ISED seeks comments on the following proposals:**

- 1. Primary TT&C and network operations center for all NGSO systems must be located within Canadian territory;**
- 2. A description and planned location of the facilities must be included in license applications;**
- 3. Confirmation of the final location of these facilities will be included in the second implementation milestone as part of the conditions of license; and**
- 4. Construction of the facilities will be included in the milestone associated with the first satellite(s) being in operation.**

SpaceX has no comment on these proposals. As noted in the General Comments above, we recall that any requirement governing the location of an NGSO system's primary TT&C and network operations center only applies to domestic space stations/satellites licensed by Canada, as opposed to systems licensed in other jurisdictions but which offer service to earth stations in Canada.

**C. ISED seeks comments on the following proposals on Canadian coverage:**

- 1. All commercial NGSO FSS/BSS satellites must cover 100% of Canadian territory on a 24/7 basis;**
- 2. There must be a sufficient number of gateway stations located in Canada to provide services throughout 100% of Canadian territory:**
  - a. Two for LEO systems without ISL;**
  - b. One for LEO systems with ISL; and**
  - c. One for MEO and HEO systems;**
- 3. A description and planned location of the gateway stations must be included in the license application;**
- 4. Confirmation of the final location of the gateway stations will be included in the second implementation milestone;**
- 5. The completion of the gateway stations will be included in the milestone associated with the first satellite(s) being in operation; and**
- 6. No waivers will be granted from the coverage requirement unless the applicant is already operating a constellation that provides coverage to 100% of Canadian territory.**

While SpaceX understands ISED's interest in ensuring the maximum possible coverage of Canada's population by NGSO systems licensed in Canada, a mandate of 100% geographic coverage may result in a high barrier to entry or deterrent to innovation, given the significant portion of Canada's landmass that is sparsely – or not at all –

populated and the resources required to provide continuous coverage to the entire country.

In particular, the northernmost portion of Canada extends above 70° North Latitude. Providing service on a continuous basis at such extreme latitudes requires NGSO satellites operating in a highly inclined orbital plane – which could impose a significant cost to achieve coverage that may not fit the business plan of the system’s operator. For example, Space Norway has proposed an NGSO system specifically designed to provide pan-Arctic service to areas above 55° North Latitude, which would not be capable of providing continuous service to the rest of Canada.

This is not an issue that is exclusive to Canada. For example, NGSO systems that operate near the plane of the equator may not be able to provide service in high-latitude regions, while systems that concentrate coverage in a particular region of the world may not be able to provide service to “all locations” in the required area. Thus, a rule that requires 100% geographic coverage may not accommodate an innovative NGSO design that would meet an identifiable market need. Domestic coverage requirements, particularly for a country as large as Canada, would impose undue constraints on NGSO system design, potentially requiring an operator to employ multiple NGSO constellations to meet the requirement.

In addition, recalling the response to Question A, above, regarding spectrum sharing and efficiency, SpaceX once again urges ISED to adopt a licensing regime that encourages efficient spectrum sharing among NGSO systems. In doing so, ISED would incentivize the development of multiple NGSO FSS systems able to appropriately share spectrum and coordinate, making a coverage requirement for any one system unnecessary from a spectrum management perspective.

**D. ISED seeks comments on the following proposals related to capacity for Canadian users:**

- 1. Licensees of LEO systems must reserve 100% of capacity for the Canadian market while the satellites are over Canada, as described in section 6.3.2;**
- 2. Such capacity must be reserved for the term of the license;**
- 3. Licensees of MEO and HEO systems must reserve, for each satellite, capacity for use by Canadians that is equal to the proportion of the Canadian territory covered vis-à-vis the total territory covered by that individual satellite; and**
- 4. Such capacity must be reserved until time of launch.**

SpaceX has no comment on these proposals.

**E. ISED seeks comments on the proposal to no longer assess coexistence with authorized and approved Canadian NGSO systems as part of the license application process.**

SpaceX has no comment on this proposal.

**F. ISED seeks comments on the following proposals to modify the implementation milestones for large NGSO systems to require that:**

- 1. One-third of the authorized constellation be deployed by Year 6; and**
- 2. The full constellation be deployed by Year 9.**

SpaceX appreciates ISED's continued understanding that implementation milestone flexibility is a requirement when considering large and mega NGSO systems.<sup>4</sup> Under the current Procedures, all satellites authorized in an NGSO system must be launched and begin operations within six years of license grant.<sup>5</sup> ISED has established such milestone requirements for satellite system implementation in order to deter warehousing (i.e., the holding of rights to use spectrum and orbital resources by an entity that does not intend to construct, launch, and operate an authorized satellite system, is not fully committed to doing so, or finds out after accepting the license that it is unable to fulfill the associated obligations). As is the case in the United States, the requirements are intended to offset the incentives for warehousing that could harm both competition and consumers, while also encouraging the rapid deployment of new spacecraft and the optimal utilization of scarce orbital and spectrum resources.

Yet an NGSO operator may not need to launch every space station in its authorized system in order to meet the objective of demonstrating full commitment to deploy a system, nor even provide the services proposed in its application. For example, a system could begin initial service with fewer satellites and then deploy additional satellites (up to its full authorization) to increase coverage, capacity, and reliability over time as demand increases.

A "one-size-fits-all" milestone regime may not be appropriate for individual GSO satellites, smaller NGSO systems, and larger NGSO systems. Launch and operation of a GSO satellite is a significant achievement, but it culminates in a singular act that is easy to define and assess. Launch and operation of a small NGSO system involves a greater number of events, but evaluating completion of that goal is still likely to be a straightforward exercise. By contrast, large and mega NGSO systems may involve hundreds or thousands of satellites, but beyond anticipated initial demand, their further deployment may be incremental in order to add coverage or capacity over time to track growth in demand for services. Simply designing, constructing, and deploying even the

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<sup>4</sup> Consultation, ¶37.

<sup>5</sup> See *Procedures*, Section 4.1 and Annex B.

initial stage necessary to begin operations of a large or mega NGSO system will require a significant investment of resources – considerably more than reasonably sufficient to demonstrate that the licensee is fully committed to bearing the cost and risk of operating its authorized system. Indeed, these initial deployments may require greater investment of resources than complete deployment of many smaller systems. Launching an initial system that is capable of providing continuous service and coverage, for example, could be used as a measure of the licensee’s commitment and intent to fully invest in its proposed system. However, beyond meeting the standard needed to allay fears of spectrum warehousing, further constraining the NGSO operators’ flexibility to deploy against shifting demands for capacity or coverage would not serve the public interest.

When discussing a large or mega NGSO system, it would be more appropriate to employ an approach that does not establish an arbitrary term of years in which to launch and operate the entire authorized system, but which could assure that licensed assets are being put to productive use, allow market forces to dictate the pace of deployment once operations have begun, and ultimately cap the number of satellites in the system once operations reach a steady state.

Again, while SpaceX will not be a domestically licensed NGSO system, the decisions made by ISED may well influence counterpart agencies in other countries. Therefore, SpaceX encourages ISED to employ an approach that is not only best for the development of NGSO service in Canada, but sets an example for regulators around the world.

**G. ISED seeks comments on the proposal to define large constellations as those with 30 or more satellites.**

SpaceX appreciates ISED’s intent to assign a definition to large constellations in order to better differentiate such systems from an individual GSO satellite and smaller NGSO constellations. However, rather than assigning an arbitrary number, SpaceX encourages ISED to instead employ a functional definition whereby a “large constellation” meets certain criteria in terms of, for example, minimum thresholds of service or coverage provided.

By employing a functional definition, ISED minimizes the need to revisit the issue of refining a set number of satellites at a future date. Indeed, as NGSO technology and broadband service needs continue to evolve, a minimum number of satellites may become an outdated standard that unintentionally limits NGSO service or business plan development.

**H. ISED seeks views on the following mechanisms that could be implemented in the event of unsuccessful domestic coordination:**

- 1. The imposition of spectrum sharing during in-line interference events;**
- 2. What would be an appropriate angle to define in-line events;**
- 3. Whether the spectrum should be split on an equal basis or reflect the regulatory status (authorization) of the systems involved;**
- 4. The mandated use of a third party dispute resolution process, prior to seeking the Department's assistance in resolving a coordination dispute; and**
- 5. Which of the two dispute resolution processes referenced in paragraph 46 should be adopted.**

Although ISED's intent with this question appears to directly address the issue of dispute resolution in the context of domestic coordination, SpaceX notes that when considering large or mega NGSO systems, the satellites will traverse multiple jurisdictions regardless of where they are licensed, and there is the potential for multiple "domestic" coordination requirements to come into play. We encourage ISED to further consider and consult on appropriate dispute resolution mechanisms that would also be appropriate for large or mega NGSO consultations.

**I. ISED seeks comments on its proposal to continue approving the use of foreign-licensed NGSO systems in Canada if coordination has been completed with Canadian networks, without requiring international coordination to be completed.**

SpaceX applauds ISED for proposing an approach that would not prevent the operation of foreign-licensed NGSO systems in Canada simply because coordination with systems licensed by one or more other countries was not yet completed.<sup>6</sup> The idea of not allowing an outlier – in this case a licensee or regulator in another jurisdiction – to prevent the operation of an NGSO system in Canada is a worthwhile goal that should benefit consumers and competition in Canada.

However, the threshold proposed in the Consultation – that ISED will approve foreign satellites "if coordination with Canadian networks has been completed," may bring about a similar scenario in which an outlier prevents the operation of an NGSO system in Canada. In this case, however, the outlier would be a Canadian licensee. For example, should SpaceX plan to seek approval to offer NGSO service in Canada and, as required, coordinate with appropriate Canadian licensees, there is always the potential for an entity to not *complete* the coordination process and thereby prevent SpaceX from receiving approval to offer service. Regardless of the reason for such a failure to complete coordination with a foreign NGSO, the foreign NGSO is prevented from entering the Canadian market until and unless the coordination process is completed. Such a situation jeopardizes the apparent ISED goal of not preventing an outlier from preventing operation of a foreign NGSO system in Canada.

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<sup>6</sup> Consultation, ¶49.

SpaceX notes that in the context of international frequency coordination, while successful coordination is the ideal solution, there are mechanisms in place to allow for frequency assignments even if coordination is not completed, with certain caveats – namely non-interference and non-protection.

When considering international coordination between administrations, the ITU Radio Regulations require the administration seeking coordination to *attempt* it, rather than to complete it. While it is preferable for both administrations to come to an agreement, the Radio Regulations include provisions for cases in which the receiving administration does not acknowledge the request for coordination or does not reply to the request for coordination.<sup>7</sup> In short, should the administration receiving a good-faith request for coordination fail to respond to that request, the non-responsive administration waives its right to complain about harmful interference caused by the assignment for which coordination was sought, and also agrees that the use of its own assignments will not cause harmful interference to the assignment for which coordination was sought. In other words, failure to respond to a request for coordination will not prevent the requesting administration from making an assignment and allowing use of the frequencies.

In the United Kingdom, which recently undertook a revision of its Procedures for the Management of Satellite Filings, applicants for satellite licenses are required to seek both domestic and international coordination. Ofcom's procedures allow for notification of a frequency assignment to the ITU for use by a satellite licensee in the case where international coordination has not been successfully completed, under No. 11.41 of the Radio Regulations.<sup>8</sup> Ofcom notes that such an action is considered a measure of last resort.<sup>9</sup> Similarly, with respect to domestic coordination, Ofcom takes the view that just as there is a mechanism to allow for use of spectrum when international coordination has not been successfully completed, the same concept should apply to domestic coordination.<sup>10</sup> In both cases, the applicant can access the spectrum, even if coordination has not been completed, assuming Ofcom is satisfied that adequate efforts have been made to achieve coordination. In both cases, networks recorded in this manner must operate on a non-interference and non-protection basis with any senior network with which coordination was not completed.

A similar approach could be employed in the context of foreign NGSO system coordination with Canadian spectrum users. A foreign NGSO operator seeking authorization should be advised by ISED of any required coordination with any higher

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<sup>7</sup> See *ITU Radio Regulations*, Nos. 9.45-9.49 and 9.62.

<sup>8</sup> See *Ofcom, Procedures for the Management of Satellite Filings* at 6.5.

<sup>9</sup> See *Ofcom, Procedures for the Management of Satellite Filings: A Statement on amendments to the Procedures* at 3.24.

<sup>10</sup> See *Ofcom, Procedures for the Management of Satellite Filings* at 6.10.

priority users and provided a list of other users with whom to coordinate. The NGSO operator would then make a good-faith effort to coordinate with higher priority users. There should be a clear understanding by all parties of who should be included in any coordination process and whether the requesting NGSO system will create interference. However, should the users receiving coordination requests fail to respond to the request or complete the coordination within a reasonable period of time, the foreign NGSO operator should not be prevented from receiving authorization to offer service to Canadian customers.

**J. ISED seeks comments on the following proposals:**

- 1. Spectrum that is returned to the Department will not be immediately available for re-assignment;**
- 2. ISED will publish a notice on its website indicating that spectrum has been returned; and**
- 3. ISED will begin to receive applications for the returned spectrum 30 calendar days after the notice has been published on ISED's Spectrum Management and Telecommunications website.**

SpaceX has no comment on these proposals.

**Conclusion**

SpaceX commends ISED for undertaking this consultation on the licensing framework for NGSO systems and clarification of application procedures for all satellite license applications. This is a key step in the process to lift the moratorium on new NGSO systems, thereby enabling the provision of new services to Canadian users. ISED raises important questions and has the opportunity to develop a forward-looking and flexible NGSO licensing framework that will both enable the growth and innovation in the Canadian marketplace and serve as an example for other regulators seeking to update their licensing frameworks to better suit new satellite service and technology developments.

Respectfully submitted,



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