

Before the  
**FEDERAL COMMUNICATIONS COMMISSION**  
Washington, DC 20554

In the Matter of	)	
	)	File No. SAT-PDR-20161115-00108
Telesat Canada	)	
	)	
Petition for Declaratory Ruling	)	

**COMMENTS OF WORLDVU SATELLITES LIMITED**

WorldVu Satellites Limited, d/b/a OneWeb (“OneWeb”), pursuant to Section 25.154(a) of the rules of the Federal Communications Commission (the “FCC” or “Commission”) and the Commission’s recent Public Notice,<sup>1</sup> hereby comments on Telesat Canada’s Petition for Declaratory Ruling to Grant Access to the U.S. Market for its non-geostationary (“NGSO”) satellite system in the Fixed Satellite Service (“FSS”) using Ka-band frequencies.<sup>2</sup>

OneWeb’s recently granted market access application will make competitively priced, high-speed Internet services available to unserved and underserved consumers worldwide.<sup>3</sup>

Telesat likewise proposes to offer worldwide broadband coverage, and has put itself forward as having the “experience, technical qualifications and expertise” necessary to do so.<sup>4</sup> However,

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<sup>1</sup> 47 C.F.R. § 25.154(a); Satellite Policy Branch Information, *Applications Accepted for Filing; Cut-Off Established for Additional NGSO-Like Satellite Applications or Petitions for Operations in the 12.75-13.25 GHz, 13.85-14.0 GHz, 18.6-18.8 GHz, 19.3-20.2 GHz, and 29.1-29.5 GHz Bands*, Public Notice, DA 17-524 (rel. May 26, 2017).

<sup>2</sup> 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 (filed Nov. 15, 2016) (“Petition” or “Telesat Petition”).

<sup>3</sup> WorldVu Satellites Limited, Petition for Declaratory Ruling Granting Access to the U.S. Market for the OneWeb System, IBFS File No. SAT-LOI-20160428-00041 (granted June 22, 2017) (“OneWeb Petition”).

<sup>4</sup> Telesat Petition at 6.

prior to any action on this Petition, OneWeb requests that Telesat provide certain additional information regarding its plans to address the physical coordination and space debris issues presented by its proposed orbital altitude, which overlaps with the OneWeb constellation.

**I. TELESAT’S PETITION SHOULD ACCOUNT FOR ITS OVERLAP WITH ONEWEB’S CONSTELLATION**

Telesat’s planned orbital altitude of 1,000 to 1,248 km<sup>5</sup> overlaps with OneWeb’s planned altitude, centered at 1,200 km.<sup>6</sup> Therefore, the proposed overlap of these constellations creates the potential for orbital debris issues. In order to address this issue, OneWeb proposes that Telesat maintain an approximate 125 km altitude buffer zone (the “Safety Buffer Zone”) between its constellation and other NGSO systems.<sup>7</sup> This 125 km Safety Buffer Zone allows for multiple large constellations to operate while providing the necessary physical separation to ensure a safe orbital environment.

OneWeb notes that Telesat states that its constellation will include a “minimum of 5 circular orbits with an altitude of 1248 km and an inclination angle of 37.4°” with “a minimum of 9 operating satellites” in each of these orbits,<sup>8</sup> for a total of 45 satellites in its inclined orbit.

OneWeb believes physical space debris coordination with the 45 satellites that Telesat proposes to operate in the 125 km Safety Buffer Zone may be possible and is willing to work

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<sup>5</sup> Technical Annex at 1.

<sup>6</sup> OneWeb Petition at 7.

<sup>7</sup> In order to address similar issues, OneWeb and Boeing previously agreed to operate their constellations with a 125 km orbital separation. *See* Letter from Brian D. Weimer and Bruce A. Olcott, Counsel to WorldVu Satellites Limited and The Boeing Company, to Marlene H. Dortch, Secretary, FCC, *Re: WorldVu Satellites Limited, Petition for a Declaratory Ruling Granting Access to the U.S. Market for the OneWeb System, File No. SAT-LOI-20160428-00041 (Call Sign S2963) & The Boeing Company, Application for Authority to Launch and Operate a Non-Geostationary Low Earth Orbit Satellite System in the Fixed Satellite Service, File Nos. SAT-LOA-20160622-00058 and SAT-AMD-20170301-00030 (Call Sign S2966)* (Mar. 23, 2017).

<sup>8</sup> Technical Annex at 1.

cooperatively with Telesat to ensure a safe orbital environment. However, the Commission should condition any grant of the Telesat Petition on Telesat's commitment to maintain an appropriate orbital separation of 125 km for its 45 requested satellites, subject to physical coordination with OneWeb.<sup>9</sup>

OneWeb notes that Telesat's promise to coordinate with other users of its proposed frequency bands – including with co-frequency NGSO systems – are predicated on a constellation with a “minimum” of 117 satellites, plus in-orbit spares.<sup>10</sup> In order to provide greater certainty to the shared orbital environment between Telesat and OneWeb, any grant of the Telesat Petition should also be limited to Telesat's requested 117 satellites. If Telesat requires additional satellites at some point in the future, it can accordingly apply to modify its market access grant.

## **II. TELESAT'S ORBITAL DEBRIS SHOWING NEEDS TO MORE FULLY ASSESS THE RISK OF IT BECOMING A SOURCE OF ORBITAL DEBRIS**

In order to fully evaluate the orbital debris issues presented by the deployment of the Telesat constellation, Telesat must provide some additional information regarding its operational parameters. For example, the following information would allow the Commission and other interested parties to more fully evaluate Telesat's orbital debris showing:

- the probability of collision with debris <1 cm that could result in loss of ability to deorbit;
- the accuracy with which orbital parameter knowledge will be maintained;
- the risk to the International Space Station (“ISS”) posed by deorbiting Telesat satellites;
- the quantity of fuel being reserved for deorbit;
- the method for addressing fuel gauging uncertainty; and
- with respect to intra-constellation conjunctions, the nominal miss distances, sensitivities of these miss distances to orbital parameter variations, and the constraints this imposes on station-keeping requirements.

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<sup>9</sup> Technical Annex at 1.

<sup>10</sup> See Technical Annex 1, 31.

Some of the information Telesat did provide in its Petition raises additional questions that should be more fully addressed. For example, Telesat states that apogee and perigee will be maintained to within 300 m, inclination to within 0.04°, and right ascension of the ascending node (“RAAN”) to within 1°. <sup>11</sup> However, the natural evolution of eccentricity will result in a deviation of more than 300 m in apogee and perigee from the mean target altitude, and RAAN for a LEO satellite is subject to secular perturbations, resulting in it taking on all values (0°-360°). Telesat should therefore elaborate on how these parameter ranges are intended to be interpreted.

With regard to disposal, Telesat states that the “decaying lower orbit” used for disposal will have an apogee of less than 1,000 km and a perigee of 550 km or less. <sup>12</sup> However, in its response to the Commission’s supplemental questions, Telesat states the disposal orbit will be circular at an altitude of 590 km. <sup>13</sup> Telesat also states they are considering other, elliptical disposal orbits. Until these plans mature, orbital lifetime assessment and collision risk cannot be accurately evaluated.

Telesat’s collision and casualty risk analyses also raise questions. Telesat states that with a mean mission duration of seven years, the deorbit rate for the polar constellation will be eleven satellites per year and the deorbit rate for the inclined constellation will be fourteen satellites per

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<sup>11</sup> Letter from Elizabeth Neasmith, Director, Spectrum Management and Development, Telesat, to Jose Albuquerque, Chief, Satellite Division, FCC, *Re: Telesat Canada, Petition for Declaratory Ruling Requesting Access to the U.S. Market for Its Non-Geostationary Orbit Constellation, Call Sign S2976, IBFS File No. SAT-LOI-20161115-00108*, at 4 (filed Apr. 14, 2017) (“Telesat Response”).

<sup>12</sup> Telesat Petition, Technical Annex at 32.

<sup>13</sup> Telesat Response at 4.

year.<sup>14</sup> This may be a mistake, but it is unclear why the deorbit rate would be higher for Telesat's inclined constellation than for the polar constellation. Telesat also claims that the addition of deorbiting Telesat satellites to the ISS debris environment is not expected to have a significant impact on ISS collision avoidance activities.<sup>15</sup> Other than comparing the number of deorbiting satellites to the current catalog population at ISS altitudes, no quantification of the risk posed to the ISS is provided. Accurately quantifying the risks posed to the ISS by the Telesat constellation is important for maintaining a safe orbital environment.

With respect to collision probabilities, Telesat makes multiple claims that OneWeb is unable to verify. *First*, Telesat states that debris assessment software ("DAS") cannot be used to predict collision probabilities above 700 km.<sup>16</sup> DAS is designed for the evaluation of collision probabilities throughout LEO, including above 700 km. There are also a number of publicly available debris environment models (e.g., NASA's ORDEM), as well as the catalog of tracked space objects, that could be used for this assessment. *Second*, Telesat asserts that the failure of satellites in one orbital plane would pose no material risk to satellites operating in a different plane.<sup>17</sup> This claim fails to recognize the risk of intra-constellation collisions between satellites in the operational constellation that are no longer able to maneuver. *Third*, Telesat claims that a failure rate of 5% equates to one satellite failure per plane and results in probabilities of collision with >10 cm objects of 0.0012 and 0.0002, respectively, for the polar and inclined satellites.<sup>18</sup> In

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<sup>14</sup> *Id.* at 4-5.

<sup>15</sup> *Id.* at 5.

<sup>16</sup> *Id.*

<sup>17</sup> *Id.*

<sup>18</sup> *Id.*

addition to the reasons cited above, this analysis is flawed because probabilities are cited for only one or two satellites. The Commission's request is for operators to assess the collision risk introduced by different failure rates on a *constellation-wide* basis.<sup>19</sup>

Therefore, Telesat's casualty risk analysis will likely need to be revised in the future. Telesat notes that its satellites will be designed such that casualty risk from a satellite is below the guideline of 1:10,000, and such requirements will be discussed as part of the spacecraft supplier selection process.<sup>20</sup> The 1:10,000 casualty risk number was originally designed on a per-satellite basis, and as such did not consider large scale constellations. The Commission is considering whether the 1:10,000 number should be updated to a constellation-wide number, and as such, any grant should be predicated on Telesat meeting the 1:10,000 constellation requirement, if adopted, once Telesat has matured its spacecraft design and selected a spacecraft manufacturer.

### **III. TELESAT HAS NOT EFFECTIVELY SHOWN THAT IT WILL MEET APPLICABLE EPFD LIMITS**

To date, Telesat has not provided the power flux density ("PFD")/e.i.r.p. mask and SRS database files necessary to enable the Commission or any other interested party to independently assess its equivalent power flux density ("EPFD") compliance demonstration.<sup>21</sup>

Telesat has also not provided any assessment of the EPFD resulting from an inline event with a victim GSO earth station. This is often the most critical geometry and should not be

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<sup>19</sup> See Letter from Jose Albuquerque, Chief, Satellite Division, FCC, to Elizabeth Neasmith, Director, Spectrum Management and Development, Telesat, *Re: Telesat Canada, IBFS File No. SAT-PDR-20161115-00108 (Call Sign S2976)*, at 2 (Mar. 15, 2017).

<sup>20</sup> Telesat Response at 6.

<sup>21</sup> See 47 C.F.R. § 25.146.

absent from the analysis. For example, Telesat specifies a 32.8-degree exclusion angle for operations in the 19.7-20.2 GHz band, based on the rejection pattern of a 0.9 m earth station antenna.<sup>22</sup> Telesat states that this exclusion will ensure that all EPFD values fall below the statistical limits, thus negating the need for an in-depth analysis.<sup>23</sup> However, for an inline event to result in similarly low EPFD values, the satellite antenna must exhibit the same or better antenna rejection performance. Telesat has not demonstrated that its satellite antennas will provide 52 dB of rejection at this exclusion angle. Telesat has essentially performed only one part of the EPFD calculation and cannot draw overall conclusions of compliance from this.<sup>24</sup> Telesat's EPFD analysis remains incomplete and should be promptly supplemented in order for the Commission and other interested parties to assess its compliance with applicable EPFD limits.

#### **IV. TELESAT'S COVERAGE PERFORMANCE MAY NOT BE ACCURATELY REPRESENTED AND ITS LARGE GSO EXCLUSION ANGLES NEED FURTHER ANALYSIS**

One of the most important aspects of any NGSO constellation that proposes to offer end-user broadband service is its ability to offer coverage with minimal geographic gaps. FSS constellations in the Ka-band are required to offer continuous U.S. coverage – with no gaps in geographic coverage, 100% of the time.<sup>25</sup> Telesat promises global coverage and touts its ability

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<sup>22</sup> Technical Annex at 17.

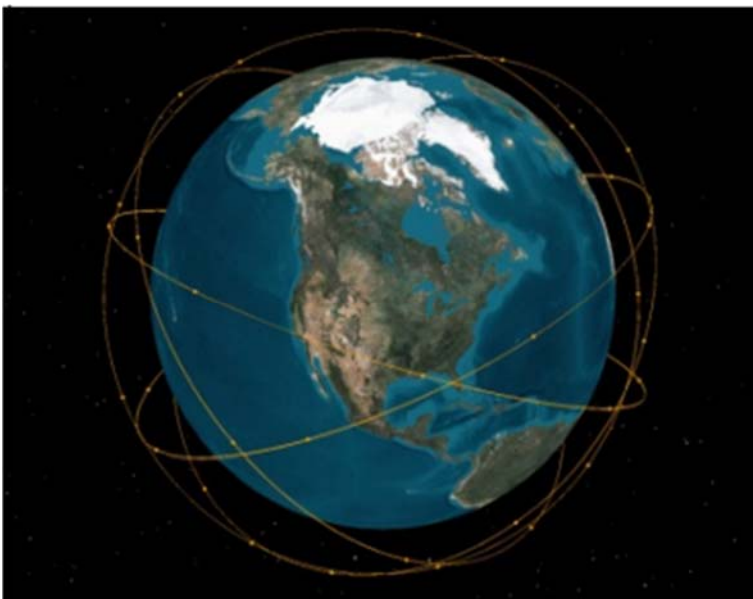
<sup>23</sup> *Id.*

<sup>24</sup> OneWeb notes that incomplete or inaccurate EPFD analyses are contained in many applications accepted by the Commission in the current Ku- and Ka-band processing round. OneWeb continues to analyze the applications of all the NGSO applicants and may further supplement its comments on the EPFD compliance demonstrations of other NGSO applicants, as necessary.

<sup>25</sup> *See* 47 C.F.R. § 25.145(c).

to reach customers worldwide with a high degree of reliability and to “meet[] the requirements of increasingly-prevalent latency-sensitive applications.”<sup>26</sup> However, its proposed constellation design, large GSO discrimination angles, and its use of a single wide-area beam raise some doubts about Telesat’s ability to offer continuous coverage to the U.S.

Telesat claims that its inclined orbit planes concentrate coverage over equatorial and mid-latitude areas and provides pictures and videos to substantiate this claim.<sup>27</sup> One such picture, shown below, is not in line with the specifications as provided in Telesat’s Schedule S.



In the above image, taken from the Telesat Technical Annex,<sup>28</sup> the right ascensions of ascending node (RAAN) are likely separated by 72 degrees. However, the Telesat Schedule S has inclined orbit planes distributed in the following RAAN values: 0.0, 36.0, 72.0, 108.0,

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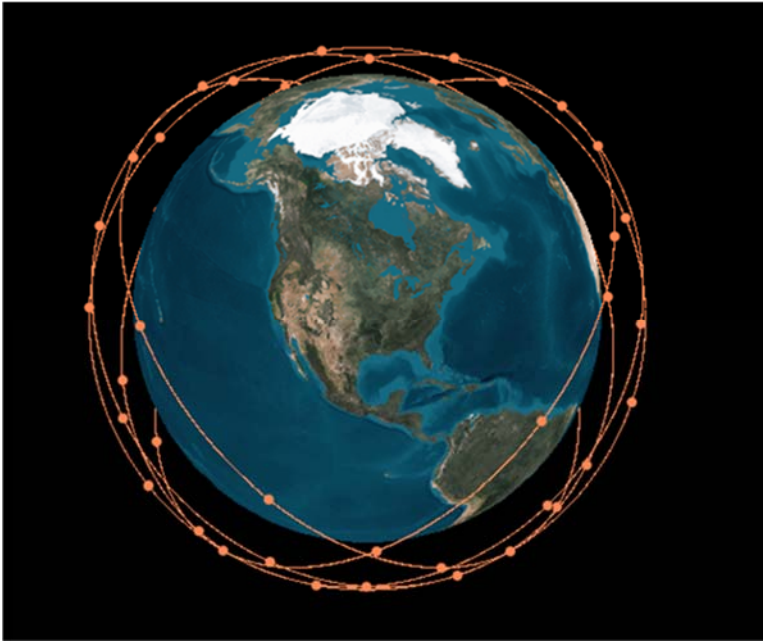
<sup>26</sup> Telesat Petition at 2.

<sup>27</sup> See, e.g., Technical Annex at 23-25.

<sup>28</sup> Technical Annex at 2.



144.0.<sup>29</sup> When modeled according to the Schedule S data, the coverage looks like the image below:



If the Schedule S geometry, rather than the Telesat Technical Annex, represents the planned architecture, the U.S. would have daily coverage gaps. Telesat should update the Commission with its intended design, including details of how it can meet the coverage requirements while also maintaining the required GSO avoidance angles and minimum elevation angles.

## V. CONCLUSION

Before permitting market access to a satellite operator, the Commission and interested parties must be given enough information to fairly judge the applicant's compliance with Commission rules and the potential for physical and spectral interference. Telesat has not provided the required detail to assess these matters and leaves too many critical aspects of its

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<sup>29</sup> Telesat Schedule S, Orbital Planes 6-10.

operations unclear. Telesat's Petition must be supplemented before the Commission can fairly decide whether to grant market access for its NGSO Ka-band constellation.

Respectfully submitted,

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June 26, 2017

**CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION**

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in these Comments, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in these Comments, and that it is complete and accurate to the best of my knowledge and belief.

Dated: June 26, 2016

/s/ Marc Dupuis

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**CERTIFICATE OF SERVICE**

I, Ashley Yeager, hereby certify that on this 26th day of June 2017, a copy of the foregoing Comments is being sent via first class, U.S. Mail, postage paid, to the following:

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