Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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

REPLY COMMENTS OF WORLDVU SATELLITES LIMITED

WorldVu Satellites Limited, d/b/a OneWeb ("OneWeb"), pursuant to Section 25.154(d) of the rules of the Federal Communications Commission (the "FCC" or "Commission") and the Commission's public notice instituting the current processing round,[1] hereby submits this reply to the Response to Comments of WorldVu Satellites Limited filed by Telesat Canada ("Telesat") regarding the above-referenced petition for U.S. market access for its proposed non-geostationary orbit ("NGSO") satellite system in the Fixed-Satellite Service ("FSS").[2]

I. TELESAT'S EPFD ANALYSIS IS INADEQUATE BECAUSE IT FAILS TO ACCOUNT FOR IN-LINE GEOMETRIES

Telesat's $EPFD_{down}$ analysis ignores critical in-line geometries that could potentially cause harmful interference to GSO operators' earth stations. Should the Commission grant Telesat's Petition, this would give Telesat an unfair advantage over other NGSO FSS applicants who comply with the ITU's EPFD limits, and would potentially grant Telesat more than its proportional share of the aggregate EPFD limits. The Commission should require Telesat to

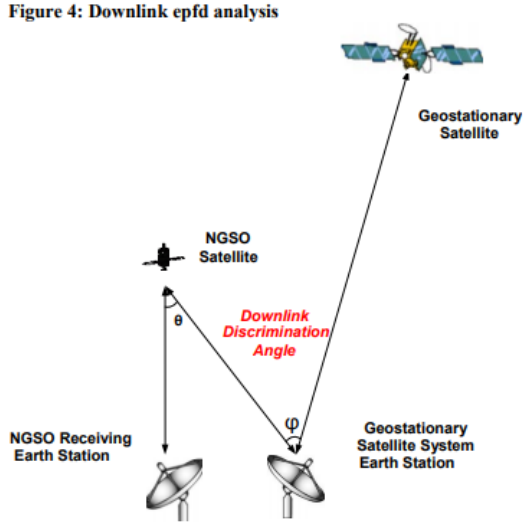
[1] *See* 47 C.F.R. § 25.154(d). *See also* Satellite Policy Branch Information; *Applications Accepted for Filing; Cut-Off Established for Additional NGSO-Like Satellite Applications or Petitions for Operations in the 12.75-13.25 GHz, 13.85-14.0 GHz, 18.6-18.8 GHz, 19.3-20.2 GHz, and 29.1-29.5 GHz Bands*,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

[2] Telesat Canada's Response to Comments of WorldVu Satellites Limited, IBFS File No. SAT-PDR-20161115-00108, Call Sign S2976 (filed July 7, 2017) ("Telesat Response").

submit an updated EPFD analysis that accounts for all relevant interference geometries prior to any action on its application.

Telesat claims it "will meet the worst-case epfd limit 100 percent of the time" by employing a large exclusion angle, such that the worst-case EPFD limits are not exceeded at Telesat's projected peak downlink e.i.r.p. densities.[3] Telesat provides the below diagram as an illustration:[4]

Figure 4: Downlink epfd analysis



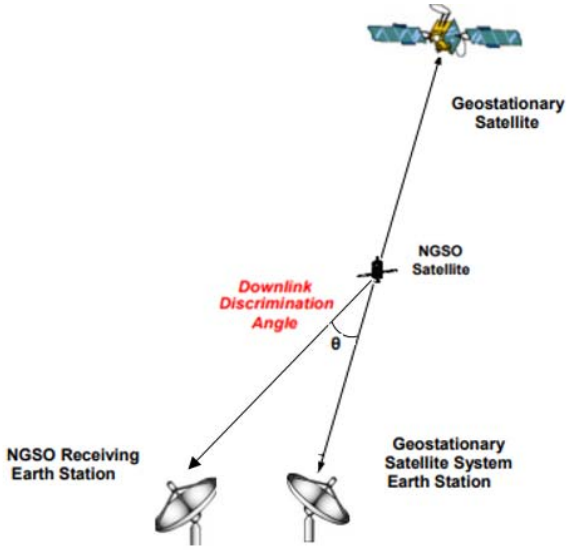
As OneWeb has previously pointed out,[5] this analysis is insufficient because it neglects one of the most critical in-line geometry cases – one where the NGSO satellite is directly in-line

[3] Telesat Canada, *Petition for Declaratory Ruling to Grant Access to the U.S. Market for Telesat's NGSO Constellation*, Technical Exhibit at 13-14, IBFS File No. SAT-PDR-20161115-00108 (filed Nov. 15, 2016) ("Technical Exhibit").

[4] Technical Exhibit at 14.

[5] *Comments of WorldVu Satellites Limited*, In re Telesat Canada Petition for Declaratory Ruling, File No. SAT-PDR-20161115-00108, at 6-7 (filed June 26, 2017) ("OneWeb Comments").

between the GSO satellite and its associated receiving earth station (illustrated below). Telesat failed to analyze this case in its application.[6]



In the interference scenario shown above, the only protection afforded the GSO receiving earth station is the off-axis rejection of the NGSO satellite transmit antenna, represented by the off-axis angle θ, because in this example the earth station receive gain discrimination is zero, since the φ angle is nil.

During an in-line event with a GSO earth station, the $EPFD_{down}$ will be equal to the PFD of the satellite that is between the GSO satellite and its earth station.[7] In Telesat's EPFD tables

[6] In the Telesat Response, Telesat incorrectly claims it has analyzed this geometry, but OneWeb respectfully believes that Telesat is mistaken. The analysis cited by Telesat addresses only the situation in which an interfering NGSO satellite appears in the sidelobes of the GSO receiving station, and not in the main beam. *See* Telesat Response at 17 (citing page 17 of its Technical Exhibit). There is no mention anywhere in Telesat's analysis of this interference scenario, nor is there any evidence of such calculations in the EPFD tables provided to the Commission. *See* Technical Exhibit at 15-18 (tables 4 through 7); Letter from Elisabeth Neasmith, Director, Spectrum Management and Development, Telesat Canada, to Jose Albuquerque, Chief, Satellite Division – International Bureau, Re: IBFS File No. SAT-LOI-20161115-00108, Attachment 1 (filed April 14, 2017) ("Telesat Letter").

for the 90cm GSO receive antenna, the maximum allowable EPFD is -193.4 dBW/m^2/40 kHz.[8] However, the e.i.r.p. density from Telesat's own calculations is -56.4 dBW/Hz,[9] which results in a maximum PFD on the Earth's surface of -141.4 dBW/m^2 over a 40 kHz bandwidth – meaning that the EPFD would also be -141.4 dBW/m2/40 kHz, which is higher than the maximum allowable EPFD. It would appear that Telesat will violate the EPFD limits during an in-line geometry like the one represented above unless there is significant satellite beam isolation.

Furthermore, Telesat provides EPFD results in its latest pleading that contradict its assertion that it will meet the worst-case EPFD limit 100 percent of the time. In its original application, Telesat claimed that it was not necessary for it to perform a thorough EPFD$_{down}$ analysis because its GSO exclusion was large enough to ensure that its maximum EPFD$_{down}$ level would not exceed -190.4 dBW/m^2/40 kHz.[10] This is clearly not the case, as shown by the latest Telesat EPFD plot (reproduced below).[11] In this plot it is clear that there are some EPFD values

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[7] When the NGSO FSS satellite is in-line with the GSO receive earth station and its corresponding satellite (as in the second figure above), the EPFD$_{down}$ equation simplifies to:

$$epfd = 10\log_{10}\left[\sum_{i=1}^{N_a} 10^{\frac{P_i}{10}} \cdot \frac{G_t(\theta_i)}{4\pi d_i^2}\right]$$

since for that case, Gr (φi) = Gr,max.

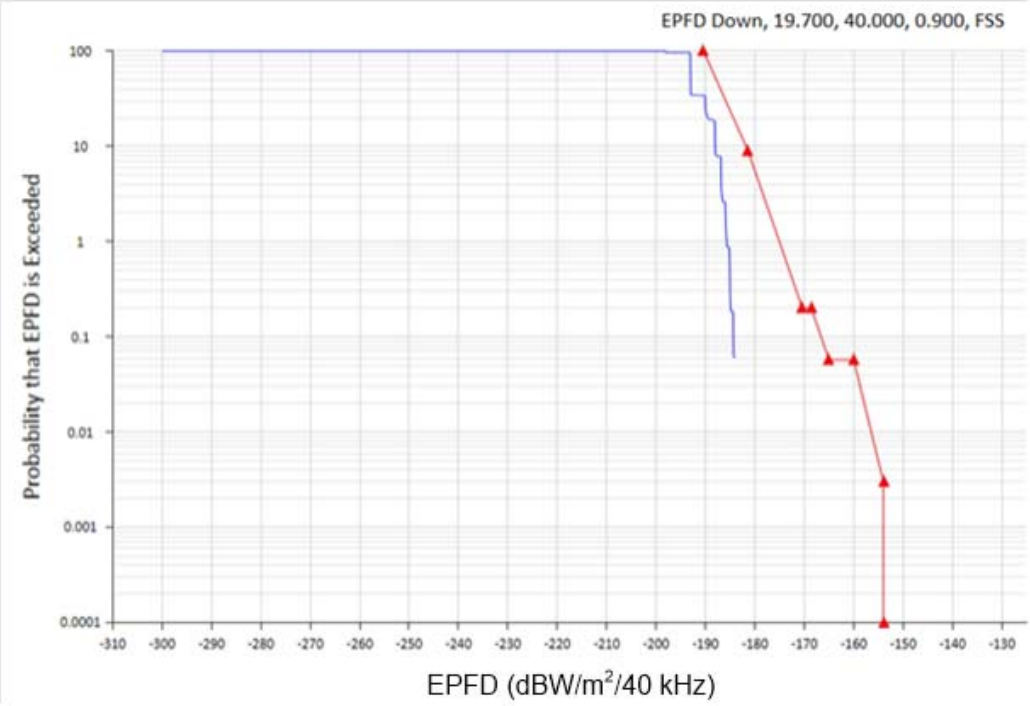
[8] Telesat Letter, Attachment 1, Tables 4 and 5.

[9] Technical Exhibit at 11.

[10] *See* Technical Exhibit at 13.

[11] Telesat Response at 19.

exceeding -185 dBW/m^2/40 kHz, which is significantly higher than the worst-case EPFD limit of -190.4 dBW/m^2/40 kHz in the 19.7-20.2 GHz frequency band.[12]



Telesat's claim that its system will never exceed the minimum EPFD limit is even more dubious for the more stringent 5m antenna limits. The most stringent EPFD level for this antenna is -200.4 dBW/m^2/40 kHz in the 19.7-20.2 GHz frequency band.[13] If the Telesat PFD is -141.4 dBW/m^2/40 kHz, as calculated above, the satellite antenna beam must provide at least 59 dB isolation toward the GSO receiving earth station to meet this EPFD level during in-line events.

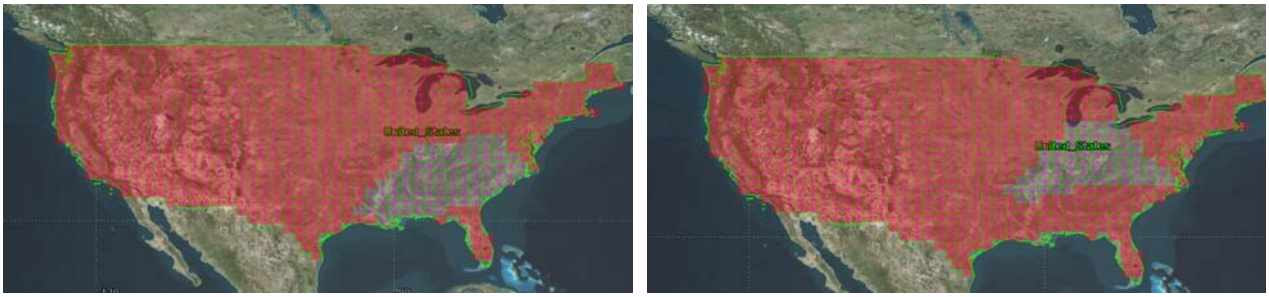
[12] *See* Int'l Telecomm. Union [ITU], Radio Regulations, Vol. 1, Ch. VI, Article 22.5CA (RR22-6 & Table 22-1C) (2016).

[13] *Id*.

Telesat should carefully review its EPFD analysis to ensure it is accurate and all relevant geometries have been analyzed.[14]

II. TELESAT'S CONSTELLATION STILL DOES NOT APPEAR TO COMPLY WITH THE COMMISSION'S DOMESTIC COVERAGE REQUIREMENT

Although Telesat has updated its Schedule S, the parameters it provides still do not demonstrate that it will meet the Commission's domestic geographic coverage requirement.[15] When coupled with its minimum elevation angles, Telesat's large minimum downlink discrimination angles (specifically, 27.5 degrees for inclined-orbit satellites and 32.8 degrees for polar-orbit satellites) overly constrain the Telesat NGSO system and will cause frequent rolling outages for large swaths of the continental United States.[16] This is illustrated in the figures below, where moving gaps in the red coverage areas are shown (in unshaded areas) at four different times.[17]

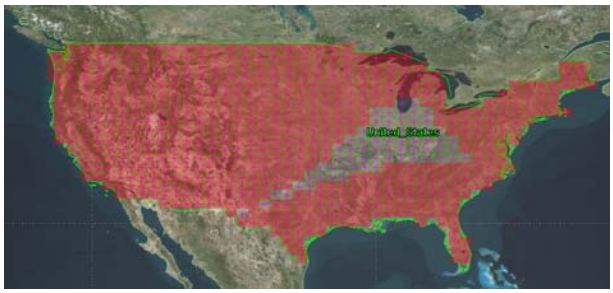


[14] Telesat has also failed to provide the required PFD/e.i.r.p. masks and associated SRS database files. These inputs are critical to interested parties' understanding of Telesat's EPFD showing. The Commission should refrain from any action on the Telesat application until it provides these masks and files.

[15] *See* 47 C.F.R. § 25.145(c)(2).

[16] *See* Technical Exhibit at 17-18.

[17] These figures use the smaller 27.5 degree downlink discrimination angle. The gaps are expected to be even larger than represented in the figures if the minimum discrimination angle of 32.8 degrees for polar-orbit satellites is considered.



Prior to any Commission action on the Telesat application, Telesat should be required to submit a revised Schedule S demonstrating compliance with Section 25.145(c) of the Commission's rules, or request a waiver of this rule.

III. DESPITE MARKED IMPROVEMENTS IN ITS ORBITAL DEBRIS MITIGATION PLAN, TELESAT MUST STILL ADDRESS THE RISK OF COLLISIONS CAUSED BY FAILED SATELLITES AND THE NEED FOR AN APPROPRIATE SEPARATION DISTANCE BETWEEN NGSO CONSTELLATIONS

Telesat provided a number of helpful updates to its orbital debris information in its Response, and OneWeb applauds Telesat for its thorough responses.[18] Nevertheless, Telesat ignores the inherent risk of collisions involving failed satellites, and resists OneWeb's suggestion for a reasonable and safe separation distance between NGSO constellations. Telesat should address each of these items more fully to prove that its planned constellation can operate safely.

Telesat addresses questions about the collision risk posed by a 1%, 5%, and 10% failure rate for its satellites, but misses the overall point of the Commission's inquiry.[19] The question was intended to analyze the intra-constellation collision risk posed at each failure rate. However, Telesat continues to provide an analysis based on failures by orbital plane against the

[18] *See* Telesat Response at 7-15.

[19] *See* Letter from Jose Albuquerque, Chief, Satellite Division – International Bureau to Elisabeth Neasmith, Director, Spectrum Management and Development, Telesat Canada, Re: IBFS File No. SAT-LOI-20161115-00108, at 2 (filed Mar. 15, 2017).

background debris population and ignores the risk of intra-constellation collisions caused by failed satellites.[20] Similarly, in considering the issue of separation distance between NGSO constellations, Telesat lists a number of relevant factors,[21] but works from the assumption that all satellites are operational. It ignores the additional distance that may be necessary to provide insurance against rogue or failed satellites in one operator's constellation colliding with those in another constellation, or to ensure that one operator does not unfairly place the burden of monitoring and maneuvering on another operator.

Telesat is correct that the 125 km separation distance suggested by OneWeb is not part of the Commission's or the ITU's formal rules.[22] However, as OneWeb pointed out in its initial Comments, adequate physical separation between large constellations is necessary to preserve a safe orbital environment, and the large number of satellites expected to be deployed in the LEO environment means that a buffer zone will be necessary for the safe operation of multiple NGSO constellations. Recently, Boeing and OneWeb mutually agreed on an appropriate orbital separation in order to maximize orbital safety.[23] Telesat should similarly confirm that it will ensure a reasonable separation distance between its constellation and other NGSO constellations.

IV. CONCLUSION

OneWeb appreciates Telesat's thorough answers to many of its concerns, especially regarding orbital debris issues. However, Telesat should further update its orbital debris mitigation plan to account for the risk of collisions involving failed satellites and to provide assurances that it will observe adequate separation distances. Telesat should also update its

[20] *See* Telesat Response at 13-14.

[21] *Id*. at 6, n.7.

[22] *See* OneWeb Comments at 2.

[23] *See id*. at 2 & n.7.

$EPFD_{down}$ analysis and its geographic coverage analysis and ensure that it conforms to the Commission's rules where the provided data casts doubt on its current compliance.

Respectfully submitted,

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July 14, 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 Reply 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 Reply Comments, and that it is complete and accurate to the best of my knowledge and belief.

Dated: July 14, 2017

/s/ Marc Dupuis

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CERTIFICATE OF SERVICE

I, Ashley Yeager, hereby certify that on this 14th day of July 2017, a copy of the foregoing Reply Comments is being sent via first class, U.S. Mail, postage paid, to the following:

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