Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
SKYNET SATELLITE CORPORATION	)	File No. SAT-LOA-________________
	)	
Application for Authority to Launch	)	
and Operate Telstar 12 Vantage	)	
at 15° W.L.	)	

APPLICATION FOR AUTHORITY TO LAUNCH AND OPERATE TELSTAR 12 VANTAGE SATELLITE AT 15° W.L.

Skynet Satellite Corporation ("Skynet"), pursuant to Section 25.114 of the Commission's rules,[1] hereby applies for authority to launch and operate a fixed satellite service ("FSS") Ku-band and Ka-band satellite, to be known as Telstar 12 Vantage ("Telstar 12V"), at the 15° W.L. orbital location.[2] Skynet seeks to use Telstar 12V to replace and expand the coverage of the Ku-band payload on Telstar 12, a Ku-band FSS satellite currently operating at 15° W.L.,[3] and to operate a Ka-band payload for the first time at this orbital location.[4]

---

[1] 47 C.F.R. § 25.114.
[2] In a letter filed on November 27, 2013, Skynet notified the Commission that it has entered at its own risk into a contract for construction of Telstar 12V. *See* letter from Joseph A. Godles, attorney for Skynet, to Marlene H. Dortch, Secretary, FCC. Because there is no file number or call sign for Telstar 12V, Skynet associated its letter with the call sign for Telstar 12.
[3] *See Loral Orion Services, Inc., Order,* 15 FCC Rcd. 12419 (IB 2000); *Orion Satellite Corp., Order and Authorization*, 10 FCC Rcd 12307 (IB 1995).
[4] Telstar 12V also will operate in the Appendix 30B Plan frequency bands (13-13.25 GHz uplink and 11.2-11.45 GHz downlink). The Appendix 30B Plan operations will be confined to Europe, and Skynet does not seek Commission authority to operate the Appendix 30B payload. The technical exhibit that is Attachment A hereto (the "Technical Exhibit") includes a breakdown of Telstar 12V's frequencies and identifies which frequencies already are employed on Telstar 12.

On September 25, 2014, the International Bureau released a letter (DA 14-1353) dismissing without prejudice the originally-filed version of this application (FCC File No. SAT-LOA.20140709-00084). Skynet is re-filing its application in accordance with the terms of the letter.

Skynet demonstrates below that it is legally and technically qualified to launch and operate Telstar 12V. Skynet also shows that grant of this application will serve the public interest by providing continuity of service for Skynet's customers and, by virtue of the expanded Ku-band coverage and the new Ka-band payload, enabling Skynet to enhance its service capabilities.

Skynet will operate Telstar 12V on a non-common carrier basis. In light of the fact that Telstar 12V will include additional frequencies, Skynet does not seek replacement satellite treatment for its application. Rather, Skynet recognizes that Telstar 12V will be subject to the Commission's bond requirements.[5]

When Skynet filed its original application, under separate cover it submitted advance publication information and a request for coordination that could be forwarded to the ITU-BR and it also provided to the Commission an ITU cost recovery letter. Although Skynet is under the impression that these ITU-related materials need not be resubmitted, it can provide duplicate copies to the Commission if requested.

---

[5] *See* 47 C.F.R. § 25.165.

I. SKYNET IS QUALIFIED TO HOLD THE REPLACEMENT AUTHORIZATION REQUESTED HEREIN

A. Legal Qualifications

Skynet is legally qualified to hold the space station authorization requested in this application. The information provided in Form 312 establishes Skynet's basic legal qualifications. Skynet's legal qualifications, moreover, are a matter of record before the Commission by virtue of the multiple Commission licenses that Skynet already holds.[6]

B. Technical Qualifications

In the accompanying Form 312, Schedule S, and Technical Exhibit, which provide the information required by Section 25.114 of the Commission's rules, Skynet demonstrates that it is technically qualified to launch and operate Telstar 12V.

---

[6] *See, e.g., BCE Inc. and Loral Skynet Corporation Transferors/Assignors and 4363205 Canada Inc., 4363213 Canada Inc., and Skynet Satellite Corporation Transferees/Assignees, Memorandum Opinion and Order and Declaratory Ruling,* 22 FCC Rcd 18049,at ¶¶ 14-15 (2007).

II. WAIVER REQUESTS

A. Request for Waiver of Section 2.106 and Footnote NG165 of the U.S. Table of Allocations

Skynet seeks authority to use spectrum in the 18.8-19.1 GHz band for gateway downlinks. The 18.8-19.3 GHz band is allocated for NGSO FSS operations on a primary basis, with no secondary allocation for GSO FSS operations. Accordingly, Skynet requests a waiver of Section 2.106 of the Commission's rules, and specifically footnote NG165 therein, to permit Skynet to operate its GSO FSS system in this band on a non-conforming, non-interference basis.[7]

Under Section 1.3 of the Commission's rules, the Commission has authority to waive its rules "for good cause shown."[8] Good cause exists if "special circumstances warrant a deviation from the general rule and such deviation will serve the public interest" better than adherence to the general rule.[9]

The Commission previously has found that there is good cause to waive footnote NG165 and permit GSO FSS operations in the 18.8-19.3 GHz band if it is shown that no interference will be caused to NGSO FSS operations and if the GSO FSS applicant agrees to accept interference from NGSO FSS operations.[10] Skynet satisfies these criteria. It demonstrates in the attached Technical Exhibit that it will protect NGSO FSS systems in the 18.8-19.1 GHz band from harmful interference, and Skynet agrees to accept

---

[7] *See*, 47 C.F.R. § 2.106 & NG165.
[8] *See*, 47 C.F.R. § 1.3; *WAIT Radio v. FCC*, 418 F.2d 1153, 1159 (D.C. Cir. 1969).
[9] *Northeast Cellular Telephone Co. v. FCC*, 897 F.2d 1164, 1166 (D.C. Cir. 1990).
[10] *See Hughes Network Systems, LLC, Declaratory Ruling*, 26 FCC Rcd 8521, at ¶¶ 12-14 (IB 2011); *contactMEO Communications, LLC, Order and Authorization,* 21 FCC Rcd 4035, at ¶ 35 (2006); *Northrop Grumman Space & Mission Systems Corporation, Order and Authorization,* 24 FCC Rcd 2330, at ¶¶ 73-75 (2009).

interference from NGSO FSS operations. Accordingly, there is good cause for a waiver of NG165.

A waiver, moreover, will facilitate more efficient operations. As set forth in the attached Technical Exhibit, a waiver will enable Skynet to operate a single Ka-band gateway in the United States that will provide links to the spot beams on T12V. This enhanced efficiency provides additional good cause for a waiver.

B. Request for Interim Waiver of Information Requirements

In a Public Notice, the International Bureau set forth a policy for granting interim waivers of certain space station application requirements.[11] Based on this policy, Skynet requests a waiver permitting it to omit technical information that is identified in Table A of the Public Notice and to use the modified format that is described in Table B of the Public Notice.[12] The information that is provided in Schedule S and the attached Technical Exhibit reflects these adjustments.[13]

C. Request for Partial Waiver of Section 25.283(c) of the Commission's Rules

Pursuant to Section 1.3 of the Commission's rules, Skynet hereby requests partial waiver of Section 25.283(c) of the Commission's rules to the extent the rule requires

[11] *Public Notice, International Bureau Adopts Policy of Granting Interim Waiver of Certain Requirements for Space Station Applications*, Report No. SPB-255, DA 14-90 (Jan. 28, 2014).

[12] The interim waiver policy was based on Part 25 rules changes that had been adopted, but not had gone into effect, when Skynet filed its original application. Although the rule changes subsequently went into effect, the Commission has not, to the best of Skynet's knowledge, changed the Schedule S instructions that address these matters. Out of an abundance of caution, therefore, Skynet in this re-filed application is continuing to request waivers based on the interim policy.

[13] Per Footnote 6 of the Public Notice, Skynet has entered a value of "1" in columns q and r of Table S7 and column b of Table S10 of Schedule S. In accordance with the instructions provided in Footnote 6, Skynet states that the entries it has made in these data fields are outside the scope of its certification concerning the accuracy of the information provided in this application.

Skynet to vent at end-of-life all remaining helium pressurant on its Telstar 12V spacecraft. Section 1.3 of the Commission's rules provides that any Commission rule may be waived for "good cause" shown. For the reasons stated below, Skynet's waiver request is supported by good cause.

Section 25.283(c) requires that after the completion of a satellite mission "all stored energy sources on board the satellite are discharged, by venting excess propellant, discharging batteries, relieving pressure vessels, and other appropriate measures." Telstar 12V is an EADS Astrium E3000 satellite.[14] The spacecraft's propulsion system design dictates that the propellant and pressurant tanks be isolated from each other when the satellite reaches the geostationary orbit. Once the propellant and pressurant tanks have been isolated from each other, the remaining helium in the pressurant tank cannot be vented, as the exit from the tank is closed by the action of firing a pyro-valve and this operation cannot be reversed. Therefore, given T12V's design, Skynet cannot vent all remaining pressurant at end-of-life.

Multiple factors, however, ensure that T12V's design is consistent with a safe flight profile. At end of life, the mass of the remaining helium, which will be contained in a tank that has a volume of 179.5 litres, will be 1.2 kilograms. The isolated helium pressurant tank will have remaining pressure of only 30 bars at that time, which is far below the burst pressure of 625 bars. In addition, the pressurant tank is located inside

[14] The contract for construction of T12V was signed with EADS Astrium, but that company now is known as Airbus Defence and Space.

the central cylinder, which means it is well protected from external impact. Accordingly, the need for safety has been appropriately addressed.

As discussed in the attached Technical Exhibit, Skynet will vent all propellant (both the fuel and the oxidant) at the end of its satellite's life, and will leave open all propulsion lines and latch valves after venting them.[15] All battery chargers will be turned off and batteries will be left in a permanent discharge state.

Skynet notes that the FCC has granted a waiver in analogous circumstances for Anik F3, which is operated by an affiliate of Skynet,[16] and for the AMAZONAS-2 spacecraft. [17] Skynet respectfully submits that a similar waiver is justified here.

III. GRANT OF THIS APPLICATION WILL SERVE THE PUBLIC INTEREST

For multiple reasons, grant of this application is in the public interest. Telstar 12 currently provides Ku-band services to customers in the United States and several other countries. Grant of this application will facilitate continuity of service by enabling Telstar 12V to provide replacement Ku-band capacity for Telstar 12. Grant of the application also will enable Skynet to enhance its service capabilities by expanding Ku-band coverage and including a Ka-band payload on Telstar 12V. Facilitating continuity of service and expanded service capabilities are unquestionably in the public interest.

---

[15] *See* Technical Exhibit, Section A8.

[16] *See* File No(s) SAT-PPL-20110630-00123 and SAT-APL-20111117-00222 (grant stamp dated April 11, 2012).

[17] Amazonas-2, SAT-PPL-20100506-00093 and SAT-APL-20101209-00257 (grant stamp dated December 21, 2010).

IV. CONCLUSION

Based upon the foregoing, Skynet respectfully requests that the Commission grant this application.

Respectfully submitted,

SKYNET SATELLITE CORPORATION

/s/Chris DiFrancesco
Chris DiFrancesco
Secretary
135 Route 202/206
Bedminster, New Jersey 07921
613-748-8700

OF COUNSEL:
Joseph A. Godles
GOLDBERG, GODLES, WIENER
& WRIGHT LLP
1229 Nineteenth Street, N.W.
Washington, DC 20036
(202) 429-4900
Counsel for Skynet Satellite Corporation

October 10, 2014

Attachment A

Technical Exhibit for "Telstar 12 VANTAGE" Satellite at 15°WL

A1. Introduction

This document is the technical attachment to the application of Skynet Satellite Corp. ("Skynet") with regard to the *Telstar 12 VANTAGE* satellite ("T12V") at the 15° west longitude (WL) geostationary orbital location. The technical information for the proposed system, as required by paragraph (d) of Section §25.114[1] of the FCC rules, is provided in this document. The information specified in paragraph (c) of that section has been provided in Schedule S and is not repeated in this document.

A2. §25.114(d)(1): General Description of the Overall System

The T12V satellite will replace the Telstar 12 satellite that is currently in operation at 15° WL.[2] The T12V satellite network will consist of a geostationary satellite at 15° WL and associated earth station facilities. The T12V satellite will provide a range of fixed-satellite services (FSS) to the United States and various countries in the Americas, Europe, Africa, and the Middle East. This satellite uses a combination of wide regional beams and spot beams.

An overview of the T12V coverage is shown in Figure 1. T12V will provide coverage in the Ku-band that is more extensive than that of Telstar 12. The satellite will have 45 active transponders of bandwidths 54, 112.5, or 236.5 MHz. The Regional beams in Figure 1 will operate in loop-back mode.

T12V will also incorporate Ka-band and Ap30B payloads. The Ap30B band will not be used in the United States and authorization for use of Ap30B spectrum is not being sought with this application.

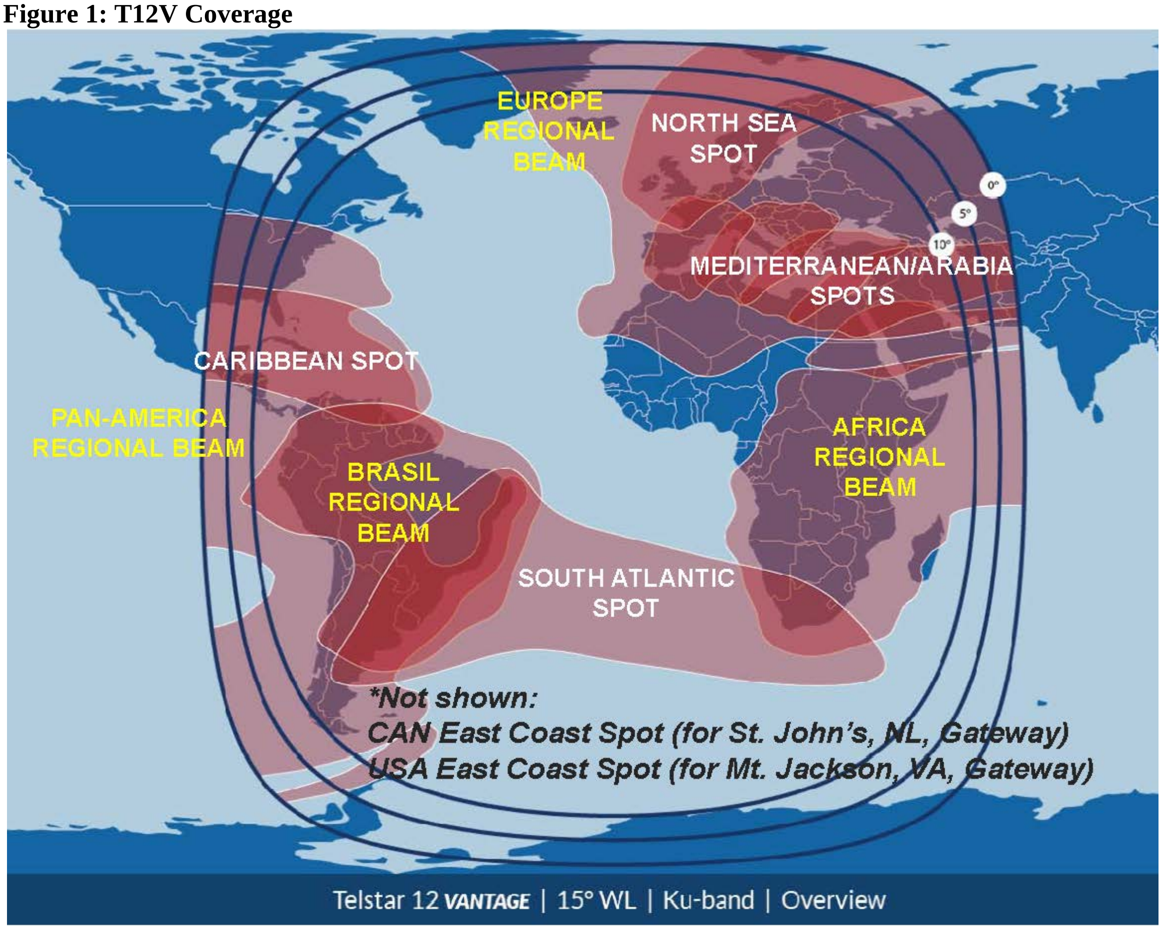
There is considerable demand for Ku-band spectrum to provide service links in the T12V spot beams. It is therefore desirable to use frequency diversity or geographic diversity to enhance Ku-band service link efficiency. This can be accomplished either by operating gateway links in a different frequency band from the service links (frequency diversity) or by providing geographic separation between the gateway and service link beams (geographic diversity). T12V has been designed to achieve these efficiency objectives.

---

[1] 47 C.F.R. §25.114
[2] FCC file number SAT-MOD-19991213-00120

With the exception of the North Sea spot beam, the spot beams in Figure 1 can operate, on a switchable basis, with either a Ka-band gateway at Skynet's Mt. Jackson, VA, USA[3] location (primary), which is frequency diverse from the Ku-band service links, or with a Ku-band gateway at St. John's, NL, Canada (alternate), which is geographically diverse from the Ku-band service link beams.[4]

Figure 1: T12V Coverage



[3] It is contemplated that the Ka-band gateway will be located at Mt. Jackson, but it could be located anywhere within the Ka-band beam coverage.
[4]The St. John's and Mt. Jackson gateway beams are not shown in Figure 1. The only Ka-band communications on T12V will be between the satellite and the gateway (i.e. there are no Ka-band service links).

The frequency bands that will be implemented on theT12V satellite are summarized in Table 1.

Table 1: Frequency bands of T12V

Lower Frequency Limit (GHz)	Upper Frequency Limit (GHz)	Downlink/Uplink	Authorized on T12	Seeking Authorization on T12V
10.95	11.2	Downlink	yes	yes
11.2	11.45	Downlink	no	no
11.45	12.2	Downlink	yes	yes
12.5	12.75	Downlink	yes	yes
13.0	13.25	Uplink	no	no
13.75	14.5	Uplink	yes	yes
18.3	19.1	Downlink	no	yes
19.7	20.2	Downlink	no	yes
28.35	28.9	Uplink	no	yes
29.25	30.0	Uplink	no	yes

Skynet seeks FCC authority to operate T12V in all of the frequency bands shown in Table 1 with the exception of the Ap30B Plan frequency bands (13-13.25 GHz uplink and 11.2 – 11.45 GHz downlink), which will be used only in Europe. Skynet does not seek FCC authority to operate the Ap30B frequency bands on T12V.

The downlink bands 10.95-11.2 GHz and 11.45–11.7 GHz will be used in the United States only for international links, i.e., for service between the United States and other countries. The downlink frequency band 12.5-12.75 GHz will be used only for coverage over Europe and Africa, and will not be used within ITU Region 2.

T12V will use portions of the 18.8 – 19.3 GHz (space-to-Earth) and 28.6 – 29.1 GHz (Earth-to-space) for the gateway links. The analysis in Section A9 of this application demonstrates compatibility with NGSO FSS operations in these band segments.

In the United States, the 28.6 – 29.1 GHz band is allocated to the NGSO FSS on a primary basis and to the GSO FSS on a secondary basis. Stations operating in a secondary service cannot cause harmful interference to, and cannot seek interference protection from, stations of a primary service. As discussed in greater detail in Section A9, Skynet’s T12V operations in the United States in this band will be consistent with these obligations of a secondary user.

The 18.8 – 19.3 GHz band is allocated in the United States on an exclusive basis to the NGSO FSS. Skynet seeks a waiver to allow its T12V GSO network to operate in the 18.8 – 19.3 GHz NGSO band. As demonstrated in Section A9, Skynet will not cause harmful interference to, nor seek protection from, NGSO operations in this band.

As requested in §25.114(d)(1) an explanation of how the uplink frequency bands are connected to the downlink frequency bands is as follows:. The uplink frequency band 13.0-13.25 GHz may be connected to the downlink bands 10.95-11.2 and 11.2-11.45 GHz. The uplink band 13.75-14.0 GHz may be connected to the downlink bands 10.95-11.2, 11.7-12.2, and 12.5-12.75 GHz. The uplink band 14.0-14.5 GHz may be connected to the downlink bands 10.95-11.2, 11.2-11.45, 11.45-11.7, 11.7-12.2, 18.3-18.8, 18.8-19.1, and 19.7-20.2 GHz. The uplink band 28.35-28.9 GHz may be connected to the downlink band 11.7-12.2 GHz. The uplink band 29.25-30 GHz may be connected to the downlink band 10.95-11.2 GHz. The strapping information has been provided in the Schedule S, which provides further details of how the uplink frequency bands are connected to the downlink frequency bands as well as the corresponding beams and the geographical coverage.

The polarization used for the Ku-band signals is linear and the polarization for the Ka-band signals is circular. Frequency reuse will be exploited through the use of orthogonal polarization and geographical isolation of the beams. All transponders will contain step attenuators which can be adjusted remotely by ground commands.

The satellite TT&C operations will be performed from the following address:

1305 Industrial Park Road, Mt. Jackson, VA 22842, USA
Phone: 540-477-5520

The TT&C frequencies and polarization plan are provided in the Schedule S.

Satellite transmission on each transponder can be individually turned on and off by ground telecommand signals, enabling cessation of emissions from the satellite, as required by §25.207[5] of the Commission's rules.

A3. Space station antenna gain contours

The co-pol and cross-pol antenna gain contours, as well as the service areas for all the beams of the T12V satellite, have been provided in the GIMS database "GIMS_DB_T12V.mdb", which is submitted separately. The gain values of the contours in the GIMS database are relative to the peak gain. The peak gain values and polarization information for each of the beams is shown in Table 2.

Table 2: List of the satellite beams and their peak antenna gain values

Beam	Uplink/ Downlink	Co-pol Antenna Peak Gain (dBi)	Cross-pol Antenna Peak Gain (dBi)	Polarization
BTXH	Downlink	32.2	0.4	H
PTXV	Downlink	29.5	-1.5	V

[5] 47 C.F.R. §25.207

PTXH	Downlink	29.5	-1.5	H
ATXV	Downlink	30.7	0.4	V
ATXH	Downlink	30.7	0.4	H
ETXV	Downlink	31.1	-4.5	V
ETXH	Downlink	31.1	-4.5	H
SATXV	Downlink	29.4	-2.3	V
CTXV	Downlink	38.8	6.2	V
S1TXV	Downlink	37.5	7.3	V
S2TXV	Downlink	38.8	7.7	V
S3TXV	Downlink	38.4	7.0	V
S4TXV	Downlink	38.5	7.4	V
S5TXV	Downlink	38.1	6.4	V
S6TXV	Downlink	38.7	8.4	V
SJTXV	Downlink	39.7	9.7	V
SJTXH	Downlink	39.7	9.7	H
S1TXH	Downlink	37.5	7.3	H
MJTXR	Downlink	45.0	2.8	RHC
MJTXL	Downlink	45.0	2.8	LHC
TTACV	Downlink	21.9	-15.9	V
TTACH	Downlink	21.9	-15.9	H
BRXV	Uplink	34.0	1.9	V
PRXV	Uplink	32.1	-0.1	V
PRXH	Uplink	32.1	-0.1	H
ARXV	Uplink	31.8	0.7	V
ARXH	Uplink	31.8	0.7	H
ERXV	Uplink	32.4	-3.7	V
ERXH	Uplink	32.4	-3.7	H
SJRXV	Uplink	42.4	10.7	V
SJRXH	Uplink	42.4	10.7	H
S1RXV	Uplink	40.7	9.6	V
SARXH	Uplink	30.8	-0.5	H
CRXH	Uplink	39.8	5.3	H
S1RXH	Uplink	40.7	9.6	H
S2RXH	Uplink	39.9	9.4	H
S3RXH	Uplink	39.9	8.9	H
S4RXH	Uplink	39.8	9.0	H
S5RXH	Uplink	39.5	8.9	H
S6RXH	Uplink	39.9	9.6	H
MJRXR	Uplink	48.0	7.8	RHC
MJRXL	Uplink	48.0	7.8	LHC
TTACU	Uplink	23.8	-17.8	H

A4. Description of the types of services to be provided, areas served, transmission characteristics, performance objectives, link noise budget, typical earth station parameters, and modulation parameters

The T12V satellite will provide a range of fixed satellite services (FSS) to the United States and various countries in the Americas, Europe, Africa, and the Middle East. Services to Alaska and Hawaii cannot be provided because these areas are not visible from the satellite geostationary orbital location of 15° WL. The services provided by T12V will include VSAT services, point-to-point communication links, and video transmissions for cable head-ends.

Typical digital modulation and emission schemes that will be used, along with their performance objectives, are listed in Table 3.

Table 3: Typical modulation/emission schemes and the corresponding performance objectives

Modulation	FEC Rate	Emission Designator	Emission BW (kHz)	Total C/N Objective (dB)
QPSK	0.5	54M0G7W	54000	1.80
QPSK	0.667	54M0G7W	54000	3.90
8PSK	0.667	54M0G7W	54000	7.92
8PSK	0.889	54M0G7W	54000	11.99
QPSK	0.5	10M0G7W	10000	1.80
QPSK	0.667	10M0G7W	10000	3.90
8PSK	0.667	10M0G7W	10000	7.92
8PSK	0.889	10M0G7W	10000	11.99

For the gateway earth stations, a typical antenna diameter is 7.6m, and the terminal earth station antenna diameters will range from 1.2 m to 2.4 m. The earth station antennas will meet the antenna performance requirements specified in §25.209[6] of the Commission's rules, and the uplink transmit power will comply with the requirements of §25.204.[7] For the Ka-band gateway, the uplink equivalent isotropic radiated power (EIRP) requirements of §25.138[8] will be met.

Typical link budgets and overall performance analysis, including the analysis of the effects of each contributing noise and interference source, are provided in Table 4 and Table 5. Table 4 shows typical link budgets when both the gateway and the terminal operate in Ku band.[9] Table 5 shows typical link budgets when the terminal operates in Ku band and the gateway operates in Ka band.

Table 4: Typical link budgets when both the terminal and the Gateway operate in Ku band

TX ES Location	**Mt. Jackson, VA (38.7N,78.6W)**	**Miami, FL (25.8N,80.2W)**
RX ES Location	**Miami, FL (25.8N,80.2W)**	**Mt. Jackson, VA (38.7N,78.6W)**
Emission BW (kHz)	10000	10000
Modulation type	QPSK	8PSK
Information rate (kbps)	10000	20000
FEC Rate	0.5	0.667
Uplink Frequency (GHz)	14.157	14.219
Uplink ES antenna diameter (m)	7.6	1.2
Uplink ES antenna gain (dBi)	59.2	43.2
Uplink Antenna feed flange power (dBW)	15	21
Uplink ES to Satellite Distance (km)	40392	40190
Uplink Free-Space Loss (dB)	207.6	207.6
Satellite RX antenna gain towards the TX ES (dBi)	28.1	29
Satellite Rx system noise temperature (K)	400	400
Uplink Atten. due to Rain, Cloud, and Atmospheric Gases (dB)	4.9	7.2
Uplink Noise Temp. Increase due to Rain, Cloud, and Atmospheric Gases (K)	196.2	234.7
Uplink Thermal C/N (dB)	20.6	9.0
Uplink C/I (ASI) (dB)	34.7	18.7
Uplink C/I (Xpol) (dB)	30	30
Uplink C/I (IM) (dB)	30	30
Uplink C/(N+I) (dB)	19.6	8.5
Downlink Frequency (GHz)	11.857	11.919
Satellite TX antenna gain towards the RX ES (dBi)	27.5	27.5
Downlink Antenna feed flange power (dBW)	11.1	11.1

[6] 47 C.F.R. §25.209
[7] 47 C.F.R. §25.204
[8] 47 C.F.R. §25.138
[9] As stated in Section A2 above, the regional beams operate in Ku-band loopback mode. In the case of the spot beams, when both the gateway and the terminal operate in Ku band there will be geographic separation between the two.

Downlink ES to Satellite Distance (km)	40190	40392
Downlink Free-Space Loss (dB)	206.0	206.1
RX ES antenna diameter (m)	1.2	7.6
RX ES antenna gain (dBi)	41.6	57.7
RX ES system noise temperature (K)	150	150
Downlink Atten. due to Rain, Cloud, and Atmospheric Gases (dB)	4.85	3.05
Downlink Noise Temp. Increase due to Rain, Cloud, and Atmospheric Gases (K)	195.1	146.3
Downlink Thermal C/N (dB)	2.6	21.0
Downlink C/I (ASI) (dB)	17.1	33.2
Downlink C/I (Xpol) (dB)	30	30
Downlink C/I (IM) (dB)	30	30
Downlink C/(N+I) (dB)	2.4	19.9
Overall Link C/(N+I) (dB)	2.3	8.2
Required C/(N+I) (dB)	1.8	7.92
Margin (dB)	0.55	0.24

Table 5: Typical link budgets when terminal operates in Ku and the Gateway operates in Ka band

TX ES Location	**Mt. Jackson, VA (38.7N,78.6W)**	**Paris, France (48.9N,2.3E)**
RX ES Location	**Paris, France (48.9N,2.3E)**	**Mt. Jackson, VA (38.7N,78.6W)**
Emission BW (kHz)	10000	10000
Modulation type	8PSK	8PSK
Information rate (kbps)	26667	26667
FEC Rate	0.889	0.889
Uplink Frequency (GHz)	29.314	14.188
Uplink ES antenna diameter (m)	7.6	1.2
Uplink ES antenna gain (dBi)	65.5	43.2
Uplink Antenna feed flange power (dBW)	12.5	12
Uplink ES to Satellite Distance (km)	40392	38473
Uplink Free-Space Loss (dB)	213.9	207.2
Satellite RX antenna gain towards the TX ES (dBi)	48	37.98
Satellite Rx system noise temperature (K)	800	600
Uplink Atten. due to Rain, Cloud, and Atmospheric Gases (dB)	20.8	1.1
Uplink Noise Temp. Increase due to Rain, Cloud, and Atmospheric Gases (K)	287.6	64.9
Uplink Thermal C/N (dB)	19.5	15.2
Uplink C/I (ASI) (dB)	41.0	18.7
Uplink C/I (Xpol) (dB)	30	30
Uplink C/I (IM) (dB)	30	30
Uplink C/(N+I) (dB)	18.8	13.4
Downlink Frequency (GHz)	11.138	18.736
Satellite TX antenna gain towards the RX ES (dBi)	36.98	45

Downlink Antenna feed flange power (dBW)	7.9	7.1
Downlink ES to Satellite Distance (km)	38473	40392
Downlink Free-Space Loss (dB)	205.1	210.0
RX ES antenna diameter (m)	1.2	7.6
RX ES antenna gain (dBi)	41.0	61.6
RX ES system noise temperature (K)	150	300
Downlink Atten. due to Rain, Cloud, and Atmospheric Gases (dB)	0.55	9.4
Downlink Noise Temp. Increase due to Rain, Cloud, and Atmospheric Gases (K)	34.5	256.7
Downlink Thermal C/N (dB)	16.3	25.4
Downlink C/I (ASI) (dB)	16.6	37.1
Downlink C/I (Xpol) (dB)	30	30
Downlink C/I (IM) (dB)	30	30
Downlink C/(N+I) (dB)	13.2	23.0
Overall Link C/(N+I) (dB)	12.2	13.0
Required C/(N+I) (dB)	11.99	11.99
Margin (dB)	0.17	0.96

A5. Power flux density compliance

The T12V satellite provides coverage through multiple beams over the United States and several other countries and areas in the Americas, Europe, Africa, and the Middle East. The satellite antenna gain contours are being provided in a GIMS database file separately, and the peak EIRP levels are being provided in Schedule S. Using the GIMS software, it was verified that the PFD limits of §25.208[10] and §25.138[11] , as well as the PFD limits of the ITU Radio Regulations, are met in all the operating frequency bands. In order to demonstrate the PFD compliance in this document, for each of the satellite downlink beams the maximum PFD at the beam peak and at angles of arrival of 0°, 5°, 10°, 15°, 20°, and 25° are shown in Tables 6 to 13. In the tables, θ denotes the angle of arrival. Below is a brief description of these tables:

- Table 6 shows the maximum PFD levels for the beams that operate in the frequency band 10.95-11.2 GHz and 11.45-11.7 GHz for several angles of arrival. Also shown in this table are the PFD limits of §25.208(b) and the ITU Radio Regulations.
- Table 7 shows the maximum PFD levels at the beam peak for the beams that operate in the frequency band 10.95-11.2 GHz and 11.45-11.7 GHz. Also shown in this table are the PFD limits of §25.208(b) and the ITU Radio Regulations.
- Table 8 shows the maximum PFD levels for the beams that operate in the frequency band 11.7-12.2 GHz for several angles of arrival. Also shown in this table are the PFD limits of the ITU Radio Regulations.

[10] 47 C.F.R. §25.208
[11] 47 C.F.R. §25.138

- Table 9 shows the maximum PFD levels at the beam peak for the beams that operate in the frequency band 11.7-12.2 GHz. Also shown in this table are the PFD limits of the ITU Radio Regulations.
- Table 10 shows the maximum PFD levels for the beams that operate in the frequency band 12.5-12.75 GHz for several angles of arrival. Also shown in this table are the PFD limits of the ITU Radio Regulations.
- Table 11 shows the maximum PFD levels at the beam peak for the beams that operate in the frequency band 12.5-12.75 GHz. Also shown in this table are the PFD limits of the ITU Radio Regulations.
- Table 12 shows the maximum PFD levels for the beams that operate in the frequency bands 18.3-19.1 GHz and 19.7-20.2 GHz for several angles of arrival. Also shown in this table are the PFD limits of §25.208 and §25.138.
- Table 13 shows the maximum PFD levels at the beam peak for the beams that operate in the frequency bands 18.3-19.1 GHz and 19.7-20.2 GHz. Also shown in this table are the PFD limits of §25.208 and §25.138.

Table 6: **Maximum PFD levels at several angles of arrival for the beams that operate in the frequency band 10.95-11.2 GHz and 11.45-11.7 GHz**

Beam Name	Peak EIRP (dBW)	Transponder BW (MHz)	Peak EIRP over 4 kHz BW (dBW)	Maximum PFD (dB(W/m²/4kHz))					
				θ =0°	θ =5°	θ =10°	θ =15°	θ =20°	θ =25°
PTXV	50	54	8.7	-153.4	-153.4	-153.4	-153.4	-153.4	-153.4
PTXH	50	54	8.7	-153.4	-153.4	-153.4	-153.4	-153.4	-153.4
ETXV	51.61	54	10.3	-151.8	-151.8	-151.8	-151.8	-151.8	-151.8
ETXH	51.61	54	10.3	-151.8	-151.8	-151.8	-151.8	-151.8	-151.8
S1TXV	58	112.5	13.5	-150.2	-150.2	-148.6	-148.6	-148.6	-148.6
S2TXV	59.26	112.5	14.8	-155.3	-153.3	-153.3	-153.3	-153.3	-151.3
S3TXV	58.88	112.5	14.4	-153.7	-153.7	-153.7	-151.7	-149.7	-147.7
S4TXV	58.99	112.5	14.5	-151.6	-151.6	-151.6	-149.6	-147.6	-147.6
S5TXV	58.54	112.5	14.0	-150.5	-150.5	-148.0	-148.0	-148.0	-148.0
S6TXV	59.16	112.5	14.7	-150.4	-150.4	-147.9	-147.4	-147.4	-147.4
SJTXV	60.2	112.5	15.7	-150.2	-150.2	-150.2	-146.4	-146.4	-146.4
SJTXH	60.2	112.5	15.7	-150.2	-150.2	-150.2	-146.4	-146.4	-146.4
S1TXH	58	112.5	13.5	-150.2	-150.2	-148.6	-148.6	-148.6	-148.6
TTACV	18.4	Telemetry Emission	1.4	-162.7	-162.7	-162.7	-162.7	-162.7	-162.7
TTACH	18.4	Telemetry Emission	1.4	-162.7	-162.7	-162.7	-162.7	-162.7	-162.7
PFD limit of §25.208(b) (dB(W/m²/4kHz)				**-150.0**	**-150.0**	**-147.5**	**-145.0**	**-142.5**	**-140.0**
ITU Radio Regulations limit (dB(W/m²/4kHz)				**-150.0**	**-150.0**	**-147.5**	**-145.0**	**-142.5**	**-140.0**

Table 7: **Maximum PFD at the beam peak for the beams that operate in the frequency band 10.95-11.2 GHz and 11.45-11.7 GHz**

Beam Name	Peak EIRP (dBW)	Transponder BW (MHz)	Peak EIRP over 4 kHz BW (dBW)	Max PFD at the Beam Peak (dB(W/m²/4kHz))	θ at the Beam Peak (deg)	**PFD limit of §25.208(b) (dB(W/m²/4kHz))**	**ITU Radio Regulations limit (dB(W/m²/4kHz))**
PTXV	50	54	8.7	-153.4	34.0	**-140.0**	**-140.0**
PTXH	50	54	8.7	-153.4	34.0	**-140.0**	**-140.0**
ETXV	51.61	54	10.3	-151.8	22.8	**-141.1**	**-141.1**
ETXH	51.61	54	10.3	-151.8	22.8	**-141.1**	**-141.1**
S1TXV	58	112.5	13.5	-148.6	15.0	**-145.0**	**-145.0**
S2TXV	59.26	112.5	14.8	-147.7	44.7	**-140.0**	**-140.0**
S3TXV	58.88	112.5	14.4	-147.7	39.8	**-140.0**	**-140.0**
S4TXV	58.99	112.5	14.5	-147.6	35.8	**-140.0**	**-140.0**
S5TXV	58.54	112.5	14.0	-148.0	24.4	**-140.3**	**-140.3**
S6TXV	59.16	112.5	14.7	-147.4	25.8	**-140.0**	**-140.0**
SJTXV	60.2	112.5	15.7	-146.4	24.5	**-140.3**	**-140.3**
SJTXH	60.2	112.5	15.7	-146.4	24.5	**-140.3**	**-140.3**

S1TXH	58	112.5	13.5	-148.6	15.0	**-145.0**	**-145.0**
TTACV	18.4	Telemetry Emission	1.4	-160.7	81.6	**-140.0**	**-140.0**
TTACH	18.4	Telemetry Emission	1.4	-160.7	81.6	**-140.0**	**-140.0**

Table 8: Maximum PFD levels at several angles of arrival for the beams that operate in the frequency band 11.7-12.2 GHz

Beam Name	Peak EIRP (dBW)	Transponder BW (MHz)	Peak EIRP over 1 MHz BW (dBW)	Maximum PFD (dB(W/m²/MHz))					
				θ =0°	θ =5°	θ =10°	θ =15°	θ =20°	θ =25°
BTXH	52.71	54	35.4	-134.7	-134.7	-134.7	-132.7	-130.7	-128.7
PTXH	50	54	32.7	-129.4	-129.4	-129.4	-129.4	-129.4	-129.4
SATXV	51.05	236.5	27.3	-142.8	-140.8	-140.8	-138.8	-136.8	-136.8
CTXV	60.5	112.5	40.0	-126.2	-126.2	-124.1	-122.1	-122.1	-122.1
SJTXV	60.2	112.5	39.7	-126.2	-126.2	-126.2	-122.4	-122.4	-122.4
SJTXH	60.2	112.5	39.7	-126.2	-126.2	-126.2	-122.4	-122.4	-122.4
TTACV	18.4	Telemetry Emission	18.4	-145.7	-145.7	-145.7	-145.7	-145.7	-145.7
TTACH	18.4	Telemetry Emission	18.4	-145.7	-145.7	-145.7	-145.7	-145.7	-145.7
ITU Radio Regulations limit (dB(W/m²/MHz)				**-124.0**	**-124.0**	**-121.5**	**-119.0**	**-116.5**	**-114.0**

Table 9: Maximum PFD at the beam peak for the beams that operate in the frequency band 11.7-12.2 GHz

Beam Name	Co-pol Peak EIRP (dBW)	Transponder BW (MHz)	Peak EIRP over 1 MHz BW (dBW)	Max PFD at the Beam Peak (dB(W/m²/MHz))	θ at the beam peak (deg)	**ITU Radio Regulations limit (dB(W/m²/MHz))**
BTXH	52.71	54	11.4	-126.7	62.92	**-114.0**
PTXH	50	54	8.7	-129.4	33.96	**-114.0**
SATXV	51.05	236.5	3.3	-134.8	43.54	**-114.0**
CTXV	60.5	112.5	16.0	-122.1	25.5	**-114.0**
SJTXV	60.2	112.5	15.7	-122.4	24.5	**-114.3**
SJTXH	60.2	112.5	15.7	-122.4	24.5	**-114.3**
TTACV	18.4	Telemetry Emission	18.4	-143.7	81.6	**-114.0**
TTACH	18.4	Telemetry Emission	18.4	-143.7	81.6	**-114.0**

Table 10: **Maximum PFD levels at several angles of arrival for the beams that operate in the frequency band 12.5-12.75 GHz**

Beam Name	Peak EIRP (dBW)	Transponder BW (MHz)	Peak EIRP over 4 kHz BW (dBW)	Maximum PFD (dB(W/m^2/4kHz)) θ =0°	θ =5°	θ =10°	θ =15°	θ =20°	θ =25°
ATXV	51.13	54	9.8	-152.2	-152.2	-152.2	-152.2	-152.2	-152.2
ATXH	51.13	54	9.8	-152.2	-152.2	-152.2	-152.2	-152.2	-152.2
ETXV	51.61	54	10.3	-151.8	-151.8	-151.8	-151.8	-151.8	-151.8
ETXH	51.61	54	10.3	-151.8	-151.8	-151.8	-151.8	-151.8	-151.8
ITU Radio Regulations limit (dB(W/m^2/4kHz))				**-148.0**	**-148.0**	**-145.5**	**-143.0**	**-140.5**	**-138.0**

Table 11: **Maximum PFD at the beam peak for the beams that operate in the frequency band 12.5-12.75 GHz**

Beam Name	Co-pol Peak EIRP (dBW)	Transponder BW (MHz)	Peak EIRP over 4 kHz BW (dBW)	Max PFD at the Beam Peak (dB(W/m^2/4kHz))	θ at the beam peak (deg)	**ITU Radio Regulations limit (dB(W/m^2/4kHz))**
ATXV	51.13	54	9.8	-152.2	12.27	**-144.4**
ATXH	51.13	54	9.8	-152.2	12.27	**-144.4**
ETXV	51.61	54	10.3	-151.8	22.76	**-139.1**
ETXH	51.61	54	10.3	-151.8	22.76	**-139.1**

Table 12: **Maximum PFD levels at several angles of arrival for the beams that operate in the frequency bands 18.3-19.1 GHz and 19.7-20.2 GHz**

Beam Name	Peak EIRP (dBW)	Transponder BW (MHz)	Peak EIRP over 1 MHz BW (dBW)	Maximum PFD (dB(W/m^2/MHz)) θ =0°	θ =5°	θ =10°	θ =15°	θ =20°	θ =25°
MJTXR	64.6	112.5	44.1	-119.0	-119.0	-119.0	-119.0	-121.0	-127.0
MJTXL	64.6	112.5	44.1	-119.0	-119.0	-119.0	-119.0	-121.0	-127.0
PFD limit of §25.208 (dB(W/m^2/MHz))				**-115.0**	**-115.0**	**-112.5**	**-110.0**	**-107.5**	**-105.0**
PFD limit of §25.138 (dB(W/m^2/MHz))				**-118.0**	**-118.0**	**-118.0**	**-118.0**	**-118.0**	**-118.0**

Table 13: **Maximum PFD at the beam peak for the beams that operate in the frequency bands 18.3-19.1 GHz and 19.7-20.2 GHz**

Beam Name	Co-pol Peak EIRP (dBW)	Transponder BW (MHz)	Peak EIRP over 1 MHz BW (dBW)	Max PFD at the Beam Peak (dB(W/m^2/MHz))	θ at the beam peak (deg)	**PFD limit of §25.208 (dB(W/m^2/MHz))**	**PFD limit of §25.138 (dB(W/m^2/MHz))**
MJTXR	64.6	112.5	44.1	-119.0	11.7	**-111.7**	**-118.0**
MJTXL	64.6	112.5	44.1	-119.0	11.7	**-111.7**	**-118.0**

A6. §25.114(d)(6): Public interest considerations in support of grant

As stated in the legal narrative portion of this application, the T12V satellite will operate at 15° WL and will replace and enhance the capacity of the Telstar 12 satellite, which is currently operating at this orbital location. The Telstar 12 satellite network currently provides services to the United States and several other countries. The T12V satellite network will enable the continuity of services currently using Telstar 12 and it will also provide additional capacity, which will provide more options to consumers in the United States who will benefit from more competitive rates and a greater diversity of possible services. In addition, the Ka band segments on T12V will enhance efficiency by making it possible for a single gateway in the United States to provide links to the T12V spot beams. Grant of this application will therefore be in the public interest.

A7. §25.114(d)(7): Information specified in §25.140(a) (Interference analysis and the compatibility of the proposed system two degrees from any authorized space station)

In this section the information specified in §25.140(a)[12] is presented (as required by §25.114(d)(7)).

§25.140(a) requests the demonstration of the compatibility of the proposed space system two degrees from any authorized space stations. This demonstration is provided in this section.

Currently, the FCC database indicates neither any authorized nor any proposed geostationary satellite within two degrees of T12V (15° WL) in the operating frequency bands of T12V. Therefore, in the following, the compatibility of the T12V satellite network with potential future satellites two degrees away from T12V is demonstrated. It is assumed that the future satellites would have downlink EIRP and uplink power levels similar to those of the T12V satellite network. An analysis was performed to calculate the adjacent satellite interference (ASI). In this analysis, earth station (ES) antenna diameters of 1.2m (user terminals) and 7.6m (gateways) were considered for the T12V satellite network, and the adjacent satellites were assumed to be at 15±2° WL. The results are summarized in Tables 14 to 17. Table 14 shows the uplink carrier to interference ratios (C/I) due to ASI in Ku-band for earth station antenna diameters of 1.2m and 7.6m. Table 15 shows the

[12] 47 C.F.R. §25.140(a)

downlink C/I due to ASI in Ku-band for earth station antenna diameters of 1.2m and 7.6m. Table 16 shows the uplink C/I due to ASI in Ka-band for the gateway 7.6m earth station antenna and Table 17 shows the downlink C/I due to ASI in Ka-band for the gateway 7.6m earth station antenna. The details of the ASI calculations have been presented in Annex 1.

The ASI values presented in Tables 14 to 17 have been used in the link budget calculations of Table 4 and Table 5. From Table 4 and Table 5 it can be seen that the required carrier to noise plus interference ratios C/(N+I) are met. This confirms that the T12V satellite network can perform efficiently if there are future satellites two degrees away from it. Similarly, if there are future satellites at two degrees away from T12V, and assuming parameters for those satellite networks similar to the parameters of the T12V satellite network, it can be concluded that the ASI from T12V into those future satellites will be within acceptable limits.

Table 14: Uplink aggregate ASI from adjacent satellites at ±2 degrees away in Ku band (at 14.219 GHz)

TX Earth Station Antenna Diameter (m)	Ku-band uplink C/I due to ASI (dB)
1.2	18.7
7.6	34.7

Table 15: Downlink aggregate ASI from adjacent satellites at ±2 degrees away in Ku band (at 11.857 GHz)

RX earth Station Antenna Diameter (m)	Ku-band downlink C/I due to ASI (dB)
1.2	17.1
7.6	33.2

Table 16: Uplink aggregate ASI from adjacent satellites at ±2 degrees away in Ka band (at 29.314 GHz)

TX Earth Station Antenna Diameter (m)	Ka-band uplink C/I due to ASI (dB)
7.6	41

Table 17: Downlink aggregate ASI from adjacent satellites at ±2 degrees away in Ka band (at 18.736 GHz)

RX earth Station Antenna Diameter (m)	Ka-band downlink C/I due to ASI (dB)
7.6	37.1

A8. §25.114(d)(14): Description of the design and operational strategies that will be used to mitigate orbital debris

§25.114(d)(14)(i), Debris Release Assessment. The T12V satellite has been designed so that in the normal operation of the satellite no debris will be released by the spacecraft. The spacecraft hardware of T12V has been designed so that individual faults will not cause the loss of the entire spacecraft. All critical components (e.g., computers and control devices) have been built within the structure and shielded from external influences. Items that could not be built within the spacecraft nor shielded (e.g., antennas) are able to withstand impact. The spacecraft can be controlled through both the normal payload antennas and wide angle antennas. The likelihood of both being damaged during a small body collision is minimal. The wide angle antennas on this spacecraft are open waveguides that point towards the earth (there is one set on each side of the spacecraft and either set could be used to successfully de-orbit the spacecraft). These wide angle antennas would continue to operate even if struck and bent.

§25.114(d)(14)(ii), Accidental Explosion Assessment. Skynet has reviewed failure modes for all equipment to assess the possibility of an accidental explosion onboard the spacecraft. In order to ensure that the spacecraft does not explode on orbit, Skynet takes specific precautions. All batteries and fuel tanks are monitored for pressure or temperature variations. Alarms in the Satellite Control Center inform controllers of any variations. Additionally, long-term trending analysis is performed to monitor for any unexpected trends.

The batteries are operated utilizing the manufacturer's automatic recharging scheme. Doing so ensures that charging terminates normally without building up additional heat and pressure. As this process occurs wholly within the spacecraft, it also affords protection from command link failures (on the ground).

In order to ensure that the spacecraft has no explosive risk after it has been successfully de-orbited, stored energy sources onboard the spacecraft will be removed by venting excess propellant, and all propulsion lines and latch valves will be vented and left open. The design of the T12V spacecraft precludes complete venting at end-of-life of all remaining helium pressurant, but the limited amount of pressurant that will remain is consistent with a safe flight profile. After the de-orbiting of the satellite, the remaining helium will have a mass of 1.2 kg contained within a tank volume of 179.5 litres. For the reasons stated in the legal narrative portion of this application, therefore, Skynet seeks a waiver to allow minimal residual pressure in the propellant tank upon de-orbiting. Once de-orbit maneuvers have been completed, all battery chargers will be turned off and batteries will be left in a permanent discharge state. These steps will ensure that no buildup of energy can occur resulting in an explosion after the spacecraft is de-orbited.

§25.114(d)(14)(iii), Assessment Regarding Collision with Larger Debris and Other Space Stations. As mentioned earlier, T12V is a replacement satellite for the Telstar 12 satellite at the 15° WL geostationary orbital location. The Telstar 12 satellite has been operating at this orbital location since 1999 and Skynet has continuously monitored and minimized the probability of the space station becoming a source of debris by collisions with large debris or other space stations. Skynet will use the same approach for T12V as it has used for Telstar 12 to minimize the probability of collisions with large debris.

In order to protect against collision with other orbiting objects, Telesat Canada, a company related to Skynet, has a contract with MIT/Lincoln Labs to provide notification and high-precision orbits for drifter objects when close approaches with our operational satellites are projected. Processing of the notifications is fully automated to ensure efficient response should avoidance maneuver(s) be required to eliminate any threat of collision with the drifter object. For nearby operational satellites Skynet coordinates with operators directly and/or by providing ephemerides to the Space Data Center and the Joint Space Operations Center (JSpOC). The JSpOC also provides notifications to Skynet for any object they see approaching a Skynet satellite.

To further limit future potential for collision, Skynet will continue to monitor new satellite launches to ensure that future satellites do not present a danger to T12V. If a new satellite is located in the vicinity of T12V, Skynet will coordinate station keeping activities with the satellite operator to avoid any risk of collision.

Combined, these systems constitute a best practice approach to collision avoidance.

§25.114(d)(14)(iv), Post-Mission Disposal Plans. At end-of-life, the T12V satellite will be removed from its geostationary orbit at 15° WL to an altitude with a perigee no less than 285.4 km above the standard geostationary orbit of 35786 km. This altitude is determined by using the FCC-recommended equation in section 25.283(a)[13] regarding end-of-life satellite disposal. The corresponding calculations for the T12V satellite are presented below:

Minimum De-orbit Altitude= 36021 km + (1000×CR×A/m) (Eq.1)
CR = solar pressure radiation coefficient of the spacecraft = 1.16
A/m = area to mass ratio, in square meters per kilogram, of the spacecraft = 0.04345
Result: (Eq.1) Minimum Deorbit Altitude = 36021 km + (1000×1.16×0.04345) = 36071.4 km which is 285.4 km above the geostationary orbit of 35786 km.

The propellant needed to achieve the minimum de-orbit altitude is based on the delta-V required. Based on an estimated end-of-life mass of 2200 kg, and the delta-V required, approximately 12.5kg of propellant will be reserved to ensure that the minimum de-orbit altitude is obtained. Any remaining propellant will be consumed by further raising the orbit until combustion is no longer possible. The remaining species of propellant, either Oxidizer

[13] 47 C.F.R. §25.283(a)

(N204) or Fuel (MMH), will be vented, placing the propulsion system on the spacecraft in “safe” mode.

Propellant tracking is accomplished using a bookkeeping method consistent with industry standards. Using this method, the ground control station tracks the number of jet seconds utilized for station keeping, momentum control and other attitude control events. The amount of fuel used is determined from the number of jet seconds. This process has been calibrated using data collected from thruster tests conducted on the ground and has been found to be accurate to within a few months of life on the spacecraft.

Propellant Gauging System (PGS) tests can be performed throughout the operational life. This test uses heaters and heat transfer curves to determine the actual fuel still aboard the spacecraft. As the amount of fuel in the tanks decreases, the accuracy of the test results increases. Therefore, operationally, the PGS tests will be performed as the satellite approaches its end of propellant life in order to verify bookkeeping results.

A9. Sharing with NGSO FSS in the 28.6 – 28.9 GHz and 18.8 – 19.1 GHz Bands

In the United States, the 28.6 – 28.9 GHz band is allocated to the NGSO FSS on a primary basis and to the GSO FSS on a secondary basis. Stations operating in a secondary service cannot cause harmful interference to, nor seek interference protection from, stations of a primary service. Skynet’s T12V operations in the United States in this band will be consistent with the obligations of a secondary user. The 18.8 – 19.1 GHz band is allocated in the United States on an exclusive basis to the NGSO FSS. Skynet seeks a waiver to allow its T12V GSO network to operate in the 18.8 – 19.1 GHz NGSO band. The analysis in this section demonstrates compatibility with NGSO FSS operations in these band segments.

The FCC has authorized O3b Limited (“O3b”) to operate gateway earth stations in Hawaii[14] and Texas[15] and to operate mobile maritime terminals on a blanket basis.[16] O3b also has pending an application for a gateway in Virginia.[17] These earth stations are designed to access the U.K. – authorized O3b NGSO constellation in, among other bands, the 28.6 – 28.9 GHz and 18.8 – 19.1 GHz bands to be used by T12V. Interference analysis provided herein demonstrates that the T12V and O3b networks may operate without causing harmful interference to each other.

Currently, there are no FCC-licensed NGSO space stations that are authorized to operate in the 28.6 – 28.9 GHz and 18.8 – 19.1 GHz bands. Northrop Grumman Space and

[14] See SES-LIC-20100723-00952
[15] See SES-LIC-20130124-00089
[16] See SES-LIC-20130528-00455 (amended by File No. SES-AMD-20131025-01138)
[17] See File No. SES-LIC-20130618-00516 (amended by File No. SES-AMD-20131122-01187)

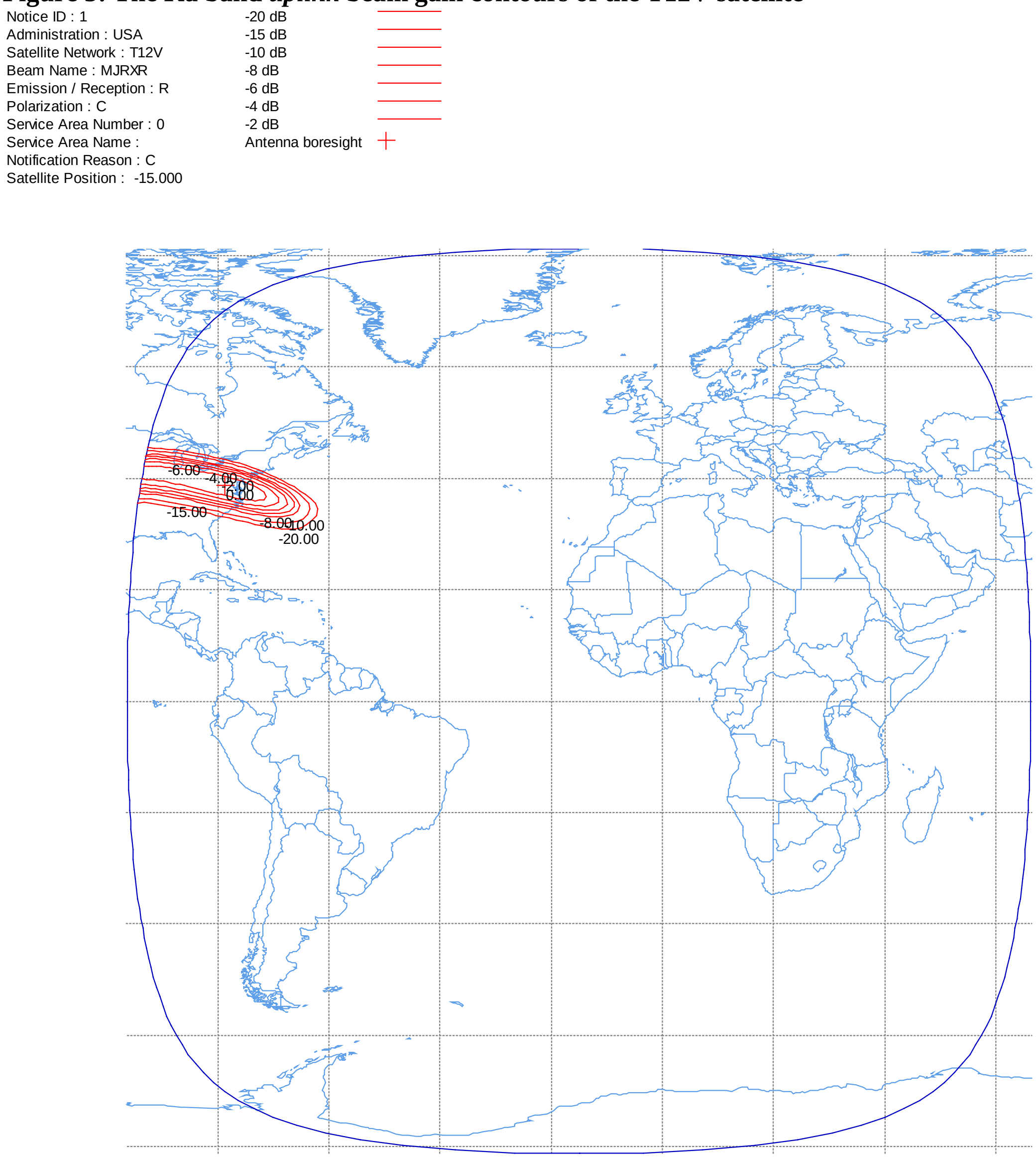
Mission Systems Corp. ("Northrop Grumman") had previously received Commission authorization for its Global EHF Satellite Network ("GESN") to use these bands. ATCONTACT Communications, LLC ("ATCONTACT") had also previously received Commission authorization for its NGSO network to use these bands. Both networks involved satellites operating in highly elliptical orbits ("HEO"). The interference analysis contained herein demonstrates that the T12V satellite network would protect HEO satellite systems with characteristics of the previously-licensed GESN and ATCONTACT Networks.

The gain contours of the Ka band downlink beam of the T12V satellite are shown in Figure 2 and the gain contours of the Ka band uplink beam of the T12V satellite are shown in Figure 3. From these figures it can be seen that the Ka band uplink and downlink beams are spot beams with their boresight at Mt. Jackson, VA. In the analysis presented below, the location of the T12V Ka gateway earth station has been considered to be in Mt. Jackson, VA. In order to consider the worst case scenario, it is also assumed that the NGSO earth station is located in Mt. Jackson, VA.

Figure 2: The Ka band *downlink* beam gain contours of the T12V satellite

Notice ID : 1	-20 dB
Administration : USA	-15 dB
Satellite Network : T12V	-10 dB
Beam Name : MJTXR	-8 dB
Emission / Reception : E	-6 dB
Polarization : C	-4 dB
Service Area Number : 0	-2 dB
Service Area Name :	Antenna boresight
Notification Reason : C	
Satellite Position : -15.000	

Figure 3: The Ka band *uplink* beam gain contours of the T12V satellite



A9.1 Compatibility with O3b

The O3b constellation will consist of eight satellites in a medium earth orbit with an altitude of 8062 km and an inclination of zero degrees (an equatorial orbit). The satellites use steerable gateway spot beams which are oriented towards the gateways as the satellite traverses its orbit until the angle of arrival at the gateway falls below a minimum. Table 18 shows the relevant parameters of the T12V network and the O3b system.

Table 18: Summary of T12V and O3b Parameters

Parameters	T12V	O3b
Earth Station Uplink Input Power Density (dBW/Hz)	-57	-55
Satellite Rx Peak Antenna Gain (dBi)	48.0	34.5
Satellite Rx System Noise Temperature (K)	800	1000
Satellite Downlink EIRP Density (dBW/Hz)	-15.9	-28.32
Earth Station Rx System Noise Temperature (K)	300	230

As mentioned earlier, the T12V gateway is considered to be at Mt. Jackson, VA, and in order to consider the worst case scenario, the O3b earth station is also assumed to be at Mt. Jackson, VA. In order to evaluate the interference impact of T12V to O3b and the interference impact of O3b to T12V, it was necessary to determine the smallest (worst case) angular separation between the T12V satellite and any of the satellites of the O3b constellation from the earth station location. An orbital mechanics simulation was performed which showed that the smallest angular separation would be 12.7 degrees. The simulation results also showed that the slant range (earth station to satellite distance) corresponding to the smallest angular separation was 40392 km for the T12V satellite and 12622 km for the O3b satellite.

Table 19 shows the predicted interference degradations to the O3b system due to operation of the T12V network and vice versa. The results show that the O3b system is adequately protected. From Table 19 it can be seen that even with the worst-case scenario assumptions, the calculated $\Delta T/T$ values are far below 6%. Hence, the T12V satellite network is compatible with the O3b satellite network.

Table 19: Worst Case Interference Calculations between T12V and O3b

Victim network		O3b	T12V
Interfering network		T12V	O3b
Victim ES latitude	° N	38.7	38.7
Victim ES longitude	° W	78.6	78.6
Uplink			
Frequency	GHz	28.7	28.7
Interfering ES uplink power density	dBW/Hz	-57.0	-55
Angular separation between the two satellites (viewed from the interfering ES)	°	12.7	12.7
Interfering ES off-axis Tx gain	dBi	1.4	1.4
Slant range (interfering path)	km	12622	40392
Free space path loss (interfering path)	dB	203.6	213.7
Victim satellite Rx peak antenna gain	dBi	34.5	48
Victim satellite Rx system noise temperature	K	1000	800

N_0	dBW/Hz	-198.6	-199.6
I_0	dBW/Hz	-224.7	-219.3
I_0 /N_0	dB	-26.1	-19.8
ΔT/T	%	0.24	1.06
Downlink			
Frequency Band	GHz	18.9	18.9
Interfering satellite downlink EIRP density	dBW/Hz	-15.9	-28.32
Slant range (interfering path)	km	40392	12622
Free space path loss (interfering path)	dB	210.1	200.0
Angular separation between the two satellites (viewed from the victim ES)	°	12.7	12.7
Victim ES off-axis Rx gain	dBi	1.4	1.4
Victim ES RX system noise temperature	K	230	300
N_0	dBW/Hz	-205.0	-203.8
I_0	dBW/Hz	-224.6	-226.9
I_0 /N_0	dB	-19.6	-23.1
ΔT/T	%	1.09	0.49

A9.2 Compatibility with Other NGSO Networks

In order to demonstrate the compatibility between the T12V satellite network and other types of NGSO satellite networks, the parameters of the GESN and ATCONTACT NGSO satellite networks, which had been previously authorized by the FCC to use the 28.6-28.9 GHz and 18.8-19.1GHz bands, have been used. Both GESN and ATCONTACT are HEO satellite networks.

Table 20 provides the parameters of these networks that are relevant to the interference analysis. These parameters were used by each of Northrop Grumman (for the GESN satellite network) and ATCONTACT to demonstrate independently that their operations in the 28.6 – 28.9 GHz and 18.8 – 19.1 GHz bands were compatible with the operations of the other's network.[18] Since the parameters of the two networks are identical, it allows a single interference analysis to be performed.

[18] See SAT-AMD-20040719-00138 and SAT-AMD-20040719-00141

Table 20: The parameters of GESN and ATCONTACT satellite networks

Parameters	GESN	ATCONTACT
Orbital parameters		
- Number of satellites	3	3
- Number of planes	3	3
- Number of satellites per plane	1	1
- Inclination (°)	63.4	63.4
- Apogee (km)	39352	39352
- Perigee (km)	1111	1111
- Minimum Tx altitude (km)	16000	16000
Satellite Rx peak antenna gain (dBi)	46.5	46.5
Satellite Rx system noise temp. (K)	504	504
ES uplink input power density (dBW/Hz)	-63.45	-63.45
Satellite downlink EIRP density (dBW/Hz)	-18	-18
ES Rx system noise temp. (K)	315	315

As mentioned earlier, the Ka band uplink and downlink beams of T12V are spot beams with their boresight at Mt. Jackson, VA. In the analysis presented below, the location of the T12V Ka gateway earth station has been considered to be in Mt. Jackson, VA. In order to consider the worst case scenario, it is also assumed that the NGSO earth station is located in Mt. Jackson, VA. In order to evaluate the interference impact of T12V to GESN or ATCONTACT and the interference impact of GESN or ATCONTACT to T12V, it was necessary to determine the smallest (worst case) angular separation between the T12V satellite and any of the satellites of the GESN or ATCONTACT constellation from the earth station location. An orbital mechanics simulation was performed which showed that the smallest angular separation would be 30.6 degrees. The simulation results also showed that the slant range (earth station to satellite distance) corresponding to the smallest angular separation was 40392 km for the T12V satellite and 18651 km for the GESN and ATCONTACT satellite.

Table 21 shows the results of the interference calculations from the T12V satellite network into the GESN and ATCONTACT satellite networks and vice versa. The calculated ΔT/T in all cases is far below 6%, indicating technical compatibility of the T12V satellite network with the GESN and ATCONTACT satellite networks.

Table 21: Worst Case Interference Calculations between T12V and GESN or ATCONTACT networks

Victim network		GESN/ATCONTACT	T12V
Interfering network		T12V	GESN/ATCONTACT
Victim ES latitude	° N	38.7	38.7
Victim ES longitude	° W	78.6	78.6
Uplink			
Frequency	GHz	28.7	28.7
Interfering ES uplink power density	dBW/Hz	-57.0	-63.45
Angular separation between the two satellites (viewed from the interfering ES)	°	30.6	30.6
Interfering ES off-axis Tx gain	dBi	-8.1	-8.1
Slant range (interfering path)	km	18651	40392
Free space path loss (interfering path)	dB	207.0	213.7
Victim satellite Rx peak antenna gain	dBi	46.5	48
Victim satellite Rx system noise temperature	K	504	800
N_0	dBW/Hz	-201.6	-199.6
I_0	dBW/Hz	-225.7	-237.3
I_0 / N_0	dB	-24.1	-37.7
ΔT/T	%	0.39	0.02
Downlink			
Frequency Band	GHz	18.9	18.9
Interfering satellite downlink EIRP density	dBW/Hz	-15.9	-18
Slant range (interfering path)	km	40392	18651
Free space path loss (interfering path)	dB	210.1	203.4
Angular separation between the two satellites (viewed from the victim ES)	°	30.6	30.6
Victim ES off-axis Rx gain	dBi	-8.1	-8.1
Victim ES RX system noise temperature	K	315	300
N_0	dBW/Hz	-203.6	-203.8
I_0	dBW/Hz	-234.1	-229.5
I_0 / N_0	dB	-30.5	-25.7
ΔT/T	%	0.09	0.27

Annex 1 to Attachment A

Details of the methodology for the calculation of C/I due to adjacent satellite interference

In this annex, the details of the methodology for the calculation of the carrier to interference ratio (C/I) due to the adjacent satellite interference (ASI) are presented and it is shown how the uplink and downlink C/I values of Tables 14 to 17 have been computed.

There is currently no authorized or proposed geostationary satellite within two degrees of T12V in the FCC database operating in the frequency bands of T12V. Therefore, in the analysis below the C/I which would be caused by potential future satellites two degrees away from T12V is calculated. It is assumed that those future satellite networks would have downlink EIRP and uplink power levels similar to those of the T12Vsatellite network.

In the following, an antenna diameter of 1.2m has been considered in Ku-band for the earth station of the T12Vsatellite network, and uplink and downlink C/I due to ASI from adjacent satellites ±2° away from T12V have been calculated. The same procedure has been used for the calculation of ASI for a 7.6m earth station antenna in both Ku and Ka bands.

Table A1shows the calculation details of the uplink C/I due to ASI from an adjacent satellite 2° away from T12V. Table A2 shows the calculation of the aggregate uplink ASI from adjacent satellites at ±2° away from T12V.

The calculation details for downlink C/I due to ASI from an adjacent satellite 2° away from T12V is shown in Table A3. The calculation of the aggregate downlink ASI from adjacent satellites at ±2° away from T12V is shown in Table A4.

Table A1: Calculation of Ku-band uplink C/I for an earth station antenna diameter of 1.2m due to ASI from an adjacent satellite network 2° away

T12V Orbital Location	Deg WL	15
Adjacent Satellite Location at 2 degrees away	Deg WL	17
Station Keeping Tolerance	Deg	0.05
Minimum Geocentric Effective Separation	Deg	1.9
Topocentric Separation (θ)	Deg	2.0
Uplink ASI C/I Calculation		
Frequency	GHz	14.219
T12V TX Earth Station		
Antenna Diameter	m	1.2
Antenna Gain	dBi	43.2
Adjacent Satellite Network TX Earth Station		
Antenna Off-axis gain toward T12V (29-25log(θ))	dBi	21.5
C/I (Uplink ASI)	dB	21.7

Table A2: Aggregate Ku-band uplink ASI from adjacent satellites +/- 2 degrees away

Uplink C/I due to ASI from the adjacent satellite +2 degrees away	dB	21.7
Uplink C/I due to ASI from the adjacent satellite -2 degrees away	dB	21.7
Aggregate Uplink C/I due to ASI	**dB**	**18.7**

Table A3: Calculation of Ku-band downlink C/I for an earth station antenna diameter of 1.2m due to ASI from an adjacent satellite network 2° away

T12V Orbital Location	Deg WL	15
Adjacent Satellite Location at 2 degrees away	Deg WL	17
Station Keeping Tolerance	Deg	0.05
Minimum Geocentric Effective Separation	Deg	1.9
Topocentric Separation (θ)	Deg	2.0
Downlink ASI C/I Calculation		
Frequency	GHz	11.857
T12V Receive Earth Station		
Antenna Diameter	m	1.2
Antenna Gain	dBi	41.6
Antenna Off-axis gain toward Adjacent Satellite (29-25log(θ))	dBi	21.5
C/I (Downlink ASI)	dB	20.1

Table A4: Aggregate Ku-band downlink ASI from adjacent satellites +/- 2 degrees away

Downlink C/I due to ASI from the adjacent satellite +2 degrees away	dB	20.1
Downlink C/I due to ASI from the adjacent satellite -2 degrees away	dB	20.1
Aggregate Downlink C/I due to ASI	**dB**	**17.1**

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 this application, that I am familiar with Part 25 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this application and that it is complete and accurate to the best of my knowledge and belief.

Bahram Borna
Satellite Spectrum Coordination Engineer
1601 Telesat Court, Ottawa,
ON, Canada K1B5P4
Phone: 613-748-8700 Ext. 2298

October 10, 2014