Technical Exhibit for Anik F3 Satellite at 118.7° West Longitude Orbital Location in Ka band

This document is an attachment to the application of Telesat with regard to Anik F3 satellite at 118.7° west longitude (WL) geostationary orbital location in Ka band. The technical information for the proposed system as required by paragraph (d) of Section §25.114[1] of the FCC rules and regulation is provided in this document. The information specified in paragraph (c) of that section has been provided in the Schedule S and is not repeated in this document.

The authorization for the operation of Anik F3 at 118.7° WL in C, Ku, and Ka band frequencies has been granted by the Canadian administration (Industry Canada). The satellite has been brought into use and is currently operating at 118.7° WL. The corresponding ITU process has been completed as well. This application is submitted to the FCC in order to seek authorization to provide services in the United States by Anik F3 in **Ka band** (The FCC has already granted the authorization to Telesat to provide services in the United States in C band and Ku band by Anik F3 via a previous application).[2]

§25.114(d)(1): General description of the overall system

The Anik F3 satellite, operating at 118.7° WL, will provide a range of Ka-band fixed satellite services (FSS). There are two Ka-band antennas on the satellite, one providing a spot beam and one providing a wide beam. The Ka-band payload on this satellite consists of two transponders for bi-directional communication between gateway and user. The operating frequencies of the Ka-band payload are 29.4-29.9 GHz in the uplink direction and 19.7-20.2 GHz in the downlink direction. The transponders can operate with the wide beam antenna carrying a wideband channel of 500 MHz bandwidth or a narrowband channel of 75 MHz. The transponders can also operate with the spot beam antenna carrying a narrowband channel of 75 MHz. The transmissions use circular polarization, right-hand and left-hand. Therefore, the satellite exploits frequency reuse by using orthogonal polarizations.

The satellite TT&C operations are performed from the Telesat Operation Center in Ottawa, Canada via the TT&C antenna located at Allan Park at the following address[3]:

Telesat
Allan Park Earth Station, 133438 Allan Park Road
West Grey Township, Allan Park, Ontario
Canada   N4N 3B8
Tel: 519-371-7490

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[1] 47 C.F.R. §25.114

[2] File number SAT-PPL-20060516-00061.

[3] The TT&C for the satellite are performed in Ku band and the corresponding characteristics have been provided in the FCC application for Anik F3 in C and Ku band (File number SAT-PPL-20060516-00061).

Satellite transmission on each active channel (TWTA chain) can be individually turned on and off by ground Tele-command signals, enabling cessation of emissions from the satellite, as required by §25.207[4] of the Commission's rules. For each of the transponders, the saturation flux density (SFD) can be changed by ground command in 1 dB steps over a range of 30 dB.

§25.114(d)(3): Space station antenna gain contours

The space station antenna gain contours for all the beams have been provided in .gxt format (For quick reference, the co-polar satellite antenna gain contours have been provided in Annex 1 as well). The gain values of the contours in those .gxt files are relative to the peak gain. The peak gain values and polarization information for each of the beams is shown in Table 1.

Table 1: List of the satellite beams and their peak values

Beam	Uplink/ Downlink	Co-pol Antenna Peak Gain [dBi]	Cross-pol Antenna Peak Gain [dBi]	Polarization
STXL	Downlink	43.52	10.26	LHC[5]
WTXL	Downlink	33.40	0.86	LHC
WTXR	Downlink	33.40	0.86	RHC[6]
SRXL	Uplink	46.27	11.53	LHC
SRXR	Uplink	46.27	11.53	RHC
WRXL	Uplink	34.41	1.30	LHC
WRXR	Uplink	34.41	1.30	RHC

As mentioned earlier, the Ka band payload consists of two transponders which are switchable between the spot beam and the wide beam antennas. Table 2 summarizes the possible transponders configurations along with the corresponding bandwidth and frequency information.

Table 2: Transponders configurations

Configuration Number	Transponder (Forward/ Return)	Bandwidth [MHz]	Uplink Beam	Uplink Center Frequency [MHz]	Uplink Polarization	Downlink Beam	Downlink Center Frequency [MHz]	Downlink Polarization
1	Forward	75	SRXR	29550	RHC	STXL	19850	LHC
	Return	75	SRXL	29550	LHC	WTXR	19850	RHC
2	Forward	75	WRXL	29550	LHC	WTXR	19850	RHC
	Return	75	WRXR	29550	RHC	WTXL	19850	LHC
3	Forward	500	WRXL	29650	LHC	WTXR	19950	RHC
	Return	500	WRXR	29650	RHC	WTXL	19950	LHC

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[4] 47 C.F.R. §25.207
[5] Left Hand Circular
[6] Right Hand Circular

§25.114(d)(4): 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 Anik F3 satellite will provide a range of Ka-band fixed satellite services (FSS) such as internet services, distant learning, and emergency services.

Typical modulation and emission schemes along with their characteristics, including the performance objectives, are listed in Table 3.

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

Digital Modulation ID	Modulation	Emission Designator	Assigned BW [kHz]	Information Rate [kbps]	FEC Rate	Total C/N Objective [dB]
1	8PSK	75M0G7W	75000	120000	0.667	7.92
2	QPSK	37M5G7W	37500	30000	0.5	1.8
3	QPSK	2M00G7W	2000	1600	0.5	1.8
4	QPSK	37M5G7W	37500	15000	0.25	-1.55

For the gateway earth station, large antennas, e.g., 8 meters, will be used. The user terminals will have earth station antennas of 0.66 to 1.0 meter in diameter, depending on the geographical location of the user terminal. All the earth stations will use uplink power control (UPC). The earth station antennas will meet the antenna performance requirements specified in §25.209[7] of the Commission's rules. For all the earth stations, the uplink transmit power will comply with the requirements of §25.204[8] and the uplink equivalent isotropic radiated power (EIRP) will meet the requirements of §25.138.[9]

Typical link budgets and overall performance analysis, including the analysis of the effects of each contributing noise and interference source, are provided in Tables 4 to 6. In these link budgets, it has been assumed that the gateway is located in Buffalo, NY. Table 4 shows the typical link budgets when the forward and return transponders are configured as in "Configuration Number 1" of Table 2 (see Table 2). Similarly, Table 5 and Table 6 show typical link budgets when the transponders have "Configuration Number 2" and "Configuration Number 3" of Table 2, respectively.

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[7] 47 C.F.R. §25.209
[8] 47 C.F.R. §25.204
[9] 47 C.F.R. §25.138

Table 4: Typical link budgets when the transponders have Configuration Number 1 of Table 2

TX ES Location	**Buffalo (42.9N, 78.9W)**	**Detroit (42.3N, 83.1W)**
RX ES Location	**Detroit (42.3N, 83.1W)**	**Buffalo (42.9N, 78.9W)**
Information (bit) rate [kbps]	120000	1600
Modulation type	8PSK	QPSK
FEC Rate	0.667	0.5
Emission BW [kHz]	75000	2000
Number of carriers per transponder	1	37
Uplink Frequency [GHz]	29.55	29.55
Uplink ES antenna diameter [m]	8	0.66
Uplink ES antenna gain [dBi]	66.0	44.3
Uplink Antenna feed flange power [dBW]	11.8	2.0
Uplink ES to Satellite Distance [km]	38925.5	38660.4
Uplink Free-Space Loss [dB]	213.7	213.6
Satellite RX antenna gain towards the TX ES [dBi]	44.8	41.6
Satellite Rx system noise temperature [K]	662.2	662.2
Uplink Atten. due to Rain, Cloud, and Atmospheric Gases [dB]	9.1	7.8
Uplink Noise Temp. Increase due to Rain, Cloud, and Atmospheric Gases [K]	254.3	241.9
Uplink Thermal C/N [dB]	20.0	2.5
Uplink C/I (ASI) [dB]	41.4	19.7
Uplink C/I (Xpol) [dB]	30.0	30.0
Uplink C/I (IM) [dB]	30.0	30.0
Uplink C/(N+I) [dB]	19.2	2.4
Downlink Frequency (GHz)	19.85	19.85
Satellite TX antenna gain towards the RX ES [dBi]	40.45	31.4
Downlink Antenna feed flange power [dBW]	18.5	2.8
Downlink ES to Satellite Distance [km]	38660.4	38925.5
Downlink Free-Space Loss [dB]	210.1	210.2
RX ES antenna diameter [m]	0.66	8.0
RX ES antenna gain [dBi]	40.9	62.5
RX ES system noise temperature [K]	250.0	250.0
Downlink Atten. due to Rain, Cloud, and Atmospheric Gases [dB]	3.8	4.3
Downlink Noise Temp. Increase due to Rain, Cloud, and Atmospheric Gases [K]	169.1	182.3
Downlink Thermal C/N [dB]	9.5	21.4
Downlink C/I (ASI) [dB]	16.2	37.9
Downlink C/I (Xpol) [dB]	30.0	30.0
Downlink C/I (IM) [dB]	30.0	30.0
Downlink C/(N+I) [dB]	8.6	20.3
Overall Link C/(N+I) [dB]	8.24	2.35
Required C/(N+I) [dB]	7.92	1.80
Margin [dB]	0.32	0.55

Table 5: Typical link budgets when the transponders have Configuration Number 2 of Table 2

TX ES Location	**Buffalo (42.9N, 78.9W)**	**Salt Lake City (40.76N, 111.91W)**
RX ES Location	**Salt Lake City (40.76N, 111.91W)**	**Buffalo (42.9N, 78.9W)**
Information (bit) rate [kbps]	30000	1600
Modulation type	QPSK	QPSK
FEC Rate	0.500	0.500
Emission BW [kHz]	37500	2000
Number of carriers per transponder	2	37
Uplink Frequency [GHz]	29.55	29.55
Uplink ES antenna diameter [m]	8	0.66
Uplink ES antenna gain [dBi]	66.0	44.3
Uplink Antenna feed flange power [dBW]	12.7	4.5
Uplink ES to Satellite Distance [km]	38925.5	37593.4
Uplink Free-Space Loss [dB]	213.7	213.4
Satellite RX antenna gain towards the TX ES [dBi]	31.1	32.0
Satellite Rx system noise temperature [K]	690.2	690.2
Uplink Atten. due to Rain, Cloud, and Atmospheric Gases [dB]	9.1	1.8
Uplink Noise Temp. Increase due to Rain, Cloud, and Atmospheric Gases [K]	254.3	98.4
Uplink Thermal C/N [dB]	10.2	2.3
Uplink C/I (ASI) [dB]	41.4	19.7
Uplink C/I (Xpol) [dB]	30.0	30.0
Uplink C/I (IM) [dB]	30.0	30.0
Uplink C/(N+I) [dB]	10.1	2.2
Downlink Frequency (GHz)	19.85	19.85
Satellite TX antenna gain towards the RX ES [dBi]	29.88	31.4
Downlink Antenna feed flange power [dBW]	15.5	2.8
Downlink ES to Satellite Distance [km]	37593.4	38925.5
Downlink Free-Space Loss [dB]	209.9	210.2
RX ES antenna diameter [m]	0.66	8
RX ES antenna gain [dBi]	40.9	62.5
RX ES system noise temperature [K]	250.0	250.0
Downlink Atten. due to Rain, Cloud, and Atmospheric Gases [dB]	0.9	4.3
Downlink Noise Temp. Increase due to Rain, Cloud, and Atmospheric Gases [K]	54.3	182.3
Downlink Thermal C/N [dB]	3.5	21.4
Downlink C/I (ASI) [dB]	16.2	37.9
Downlink C/I (Xpol) [dB]	30.0	30.0
Downlink C/I (IM) [dB]	30.0	30.0
Downlink C/(N+I) [dB]	3.2	20.3
Overall Link C/(N+I) [dB]	2.41	2.16
Required C/(N+I) [dB]	1.80	1.80
Margin [dB]	0.61	0.36

Table 6: Typical link budgets when the transponders have Configuration Number 3 of Table 2

TX ES Location	**Buffalo (42.9N, 78.9W)**	**Portland, OR (45.53N, 122.68W)**
RX ES Location	**Portland, OR (45.53N, 122.68W)**	**Buffalo (42.9N, 78.9W)**
Information (bit) rate [kbps]	15000	1600
Modulation type	QPSK	QPSK
FEC Rate	0.250	0.500
Emission BW [kHz]	37500	2000
Number of carriers per transponder	13	250
Uplink Frequency [GHz]	29.65	29.65
Uplink ES antenna diameter [m]	8	1
Uplink ES antenna gain [dBi]	66.0	48.0
Uplink Antenna feed flange power [dBW]	17.2	4.5
Uplink ES to Satellite Distance [km]	38925.5	37971.6
Uplink Free-Space Loss [dB]	213.7	213.5
Satellite RX antenna gain towards the TX ES [dBi]	31.1	32.9
Satellite Rx system noise temperature [K]	690.2	690.2
Uplink Atten. due to Rain, Cloud, and Atmospheric Gases [dB]	9.1	5.3
Uplink Noise Temp. Increase due to Rain, Cloud, and Atmospheric Gases [K]	254.3	204.4
Uplink Thermal C/N [dB]	14.7	2.7
Uplink C/I (ASI) [dB]	41.4	23.3
Uplink C/I (Xpol) [dB]	30.0	30.0
Uplink C/I (IM) [dB]	30.0	30.0
Uplink C/(N+I) [dB]	14.4	2.6
Downlink Frequency (GHz)	19.95	19.95
Satellite TX antenna gain towards the RX ES [dBi]	32.99	31.4
Downlink Antenna feed flange power [dBW]	7.4	-5.5
Downlink ES to Satellite Distance [km]	37971.6	38925.5
Downlink Free-Space Loss [dB]	210.0	210.2
RX ES antenna diameter [m]	1	8
RX ES antenna gain [dBi]	44.5	62.6
RX ES system noise temperature [K]	250.0	250.0
Downlink Atten. due to Rain, Cloud, and Atmospheric Gases [dB]	2.6	4.3
Downlink Noise Temp. Increase due to Rain, Cloud, and Atmospheric Gases [K]	130.6	182.3
Downlink Thermal C/N [dB]	-0.7	13.2
Downlink C/I (ASI) [dB]	19.9	37.9
Downlink C/I (Xpol) [dB]	30.0	30.0
Downlink C/I (IM) [dB]	30.0	30.0
Downlink C/(N+I) [dB]	-0.7	13.0
Overall Link C/(N+I) [dB]	-0.87	2.26
Required C/(N+I) [dB]	-1.55	1.80
Margin [dB]	0.68	0.46

§25.114(d)(5): Power flux density compliance

In this section the maximum power flux density (PFD) levels at the earth's surface are presented and it is demonstrated that the PFD levels produced by Anik F3 in the band 19.7-20.2 GHz comply with the power flux density (PFD) limit of §25.138.[10] According to §25.138(a)(6), in the band 19.7-20.2 GHz "PFD at the Earth's surface produced by emissions from a space station for all conditions, including clear sky, and for all methods of modulation shall not exceed a level of -118 dBW/m^2/MHz". It is worth noting that in §25.208[11] no PFD limit has been specified for the downlink Ka frequency band of Anik F3 (19.7-20.2 GHz).

Table 7 shows the peak EIRP values over 1 MHz bandwidth as well as the peak PFD values at the earth's surface for all possible transponders configurations. From this table it can be seen that the maximum PFD at the earth's surface is equal to -119.6 dB(W/m^2/MHz), which is smaller than the PFD limit of -118 dB(W/m^2/MHz), as set by §25.138(a)(6).

Table 7: Downlink PFD values for different transponders configurations

Transponders configuration Number	Transponder (Forward/ Return)	Downlink beam	Peak EIRP over 1 MHz BW [dBW]	Location of the peak antenna gain (long/lat)	Distance between the satellite and the peak gain point on the earth [km]	PFD at the peak gain point on the earth [dB(W/m^2/MHz]
1	Forward	STXL	43.27	74.33W / 45.45N	39346.9	-119.6
	Return	WTXR	33.15	122.21W / 47.53N	38147.2	-129.5
2	Forward	WTXR	33.15	122.21W / 47.53N	38147.2	-129.5
	Return	WTXL	33.15	122.21W / 47.53N	38147.2	-129.5
3	Forward	WTXR	28.38	122.21W / 47.53N	38147.2	-134.2
	Return	WTXL	24.91	122.21W / 47.53N	38147.2	-137.7

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

The Anik F3 satellite will offer capacity in Ka band that would enable consumers to use services such as broadband internet. Such services are in demand especially in remote areas where high-speed internet services may not be available through other media. In addition, the Ka band capacity offered by Anik F3 will provide more options to the consumers which in turn would result in more competitive rates and services.

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

§25.114(d)(7): Information specified in §25.140(b) (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(b)[12] are presented (as required by §25.114(d)(7)).

§25.140(b)(1) asks for presenting the information specified in §25.114 which is accomplished by the Schedule S and other sections of this Technical Exhibit. §25.140(b)(2) asks for demonstration of the compatibility of the proposed space system two degrees from any authorized space stations. This demonstration is provided in this section.

Currently, there is neither any authorized nor any proposed geostationary satellite within two degrees of Anik F3 (118.7° WL) in the Ka band frequencies of Anik F3 (19.7-20.2 GHz and 29.4-29.9 GHz). In the following, the compatibility of the Anik F3 satellite network with potential future satellites two degrees away from Anik F3 is demonstrated. Since there are currently no such satellites, it is assumed that those future satellites would have downlink EIRP and uplink power levels similar to those of the Anik F3 satellite network. An analysis was performed to calculate the adjacent satellite interference (ASI). In this analysis, earth station (ES) antenna diameters of 0.66m, 1m, and 8m were considered for the Anik F3 satelllite network, and the adjacent satellites were assumed to be at 118.7±2° WL and 118.7±4° WL. The results are summarized in Table 8 and Table 9. The uplink carrier to interference ratios (C/I) due to aggregate ASI for different earth station antenna sizes are summarized in Table 8 and the downlink C/I values due to aggregate ASI for different antenna sizes are shown in Table 9. The details of ASI calculations have been presented in Annex 2.

The ASI values presented in Table 8 and Table 9 have been used in the link budget calculations of Table 4, Table 5, and Table 6. From Tables 4, 5, and 6 it can be seen that the required carrier to noise plus interference ratios C/(N+I) are met. This confirms that the Anik F3 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 Anik F3, and considering similar parameters for those satellites to Anik F3 satellite network, it can be concluded that the ASI from Anik F3 into those future satellites will be within their tolerance.

Table 8: Uplink Aggregate ASI from adjacent satellites at ±2 and ±4 degrees away

ES Antenna Diameter [m]	Uplink C/I due to ASI [dB]
0.66	19.7
1	23.3
8	41.4

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[12] 47 C.F.R. §25.140(b)

Table 9: Downlink Aggregate ASI from adjacent satellites at ±2 and ±4 degrees away

ES Antenna Diameter [m]	Downlink C/I due to ASI [dB]
0.66	16.2
1	19.9
8	37.9

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

§25.114(d)(14)(i), Debris Release Assessment. Telesat has assessed the normal operations and post-mission disposal procedure and has determined that no debris will be released by the spacecraft. The Anik F3 satellite has been at the geostationary orbital location of 118.7° WL since April 2007 without any debris issue.

To protect from small body collisions, the spacecraft hardware of Anik F3 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 basically 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. Telesat 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, Telesat takes specific precautions. All batteries and fuel tanks are monitored for pressure or temperature variations. Alarms in the Satellite Control Center ("SCC") 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 protect the propulsion system, fuel tanks are operated in a blow down mode. Since the completion of orbit-raising, the pressurant has been isolated from the fuel system. Consequently, the pressure in the tanks has been decreasing over the life of the spacecraft. This also protects from a pressure valve failure causing the fuel tanks to become over pressurized. In order to ensure that the spacecraft has no explosive risk after it has been successfully de-orbited, all stored energy onboard the spacecraft will be removed. Upon successful de-orbit of the spacecraft, all propulsion lines and latch valves will be vented and left open. 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 in the years after the spacecraft is de-orbited.

§25.114(d)(14)(iii), Assessment Regarding Collision with Larger Debris and Other Space Stations. As mentioned earlier, Anik F3 has been at the geostationary orbital location of 118.7° WL since April 2007 and Telesat has been continuously monitoring and minimizing the probability of the space station becoming a source of debris by collisions with large debris or other operational space stations.

In order to protect against collision with other orbiting objects Telesat has a contract with MIT/Lincoln Labs to provide notification and orbits of drifter objects when close approach with our operational satellites is projected. The notification process is fully automated to ensure efficient response should avoidance maneuver(s) be required to eliminate any threat of collision with the drifter object.

To further limit future potential for collision, Telesat will continue to monitor new satellite launches to ensure that future satellites do not present a danger to Anik F3. If a new satellite is located within 0.5° of Anik F3, Telesat will coordinate station keeping activities with the satellite operator to avoid any risk of collision.

§25.114(d)(14)(iv), Post-Mission Disposal Plans. Anik F3 satellite will be removed from its geostationary orbit at 118.7° WL at a perigee altitude no less than about 300 km above the standard geostationary orbit of 35,786 km. This altitude will be determined by using the FCC-recommended equation in section 25.283(a)[13] regarding end-of-life satellite disposal. An example is described below:

Minimum Deorbit Altitude= 36,021 km + (1000×CR×A/m) (Eq.1)
CR = solar pressure radiation coefficient of the spacecraft = 1.6
A/m = area to mass ratio, in square meters per kilogram, of the spacecraft = 0.036
Result: (Eq.1) Minimum Deorbit Altitude = 36,021 km + (1000×1.6×0.036) = 36,078.6 km which is 292.6 km above the geostationary orbit of 35,786 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 2250 kg, and the delta-V required, approximately 10.5kg of propellant will be reserved to ensure minimum de-orbit altitude

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[13] 47 C.F.R. §25.283(a)

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 (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 as per industry standard. 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 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.

Annex 1

Satellite antenna gain contours

The co-polar satellite antenna gain contours are shown in Figures 1 to 7. As mentioned earlier, the co-polar and cross-polar gain contours have been provided in .gxt format as attachments to the Schedule S. The co-polar contours are provided here for quick reference. The peak gain values and polarization information for the beams have been provided in Table 1.

Figure 1: Co-polar gain contours for beam SRXL

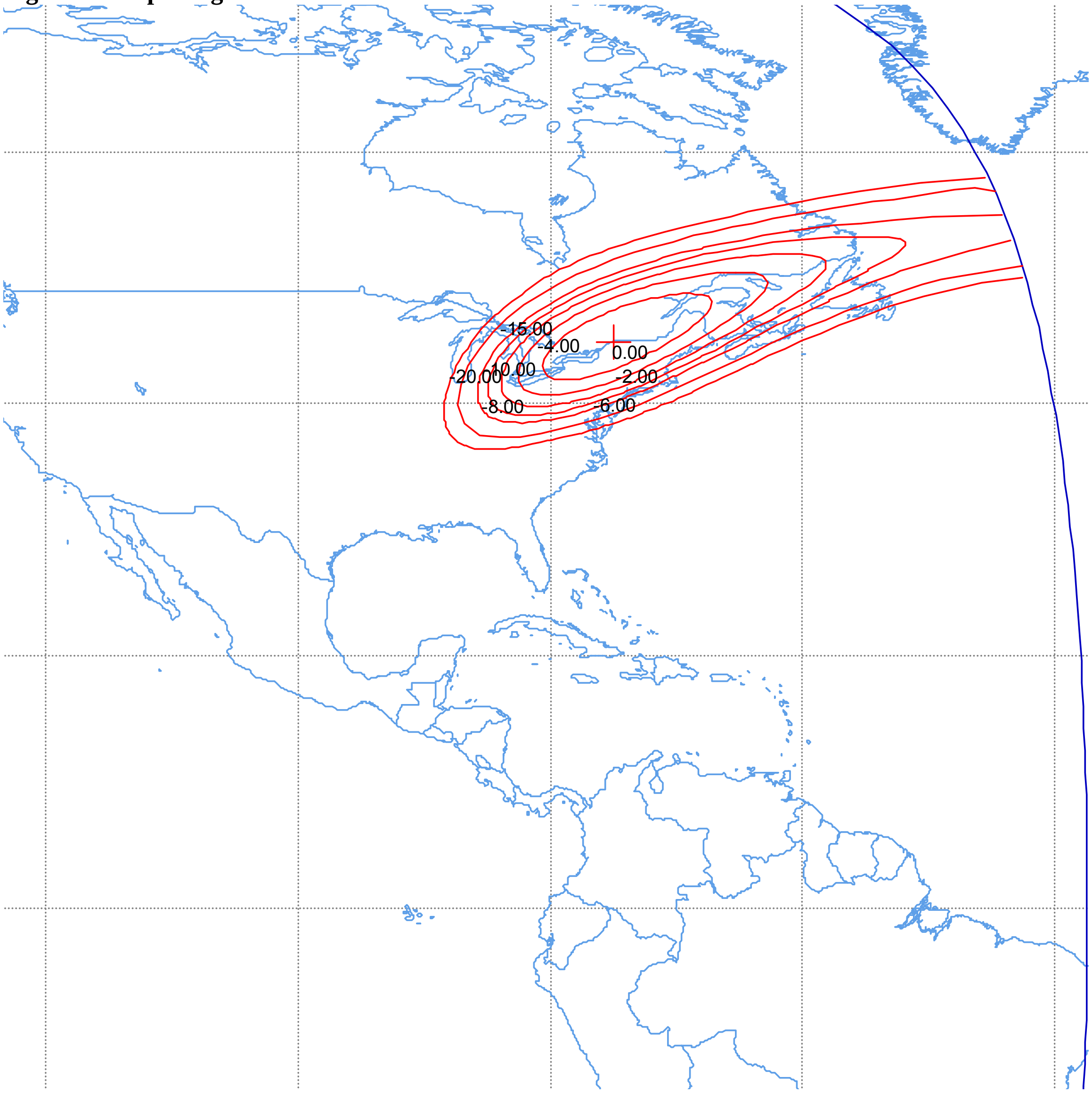


Figure 2: Co-polar gain contours for beam SRXR

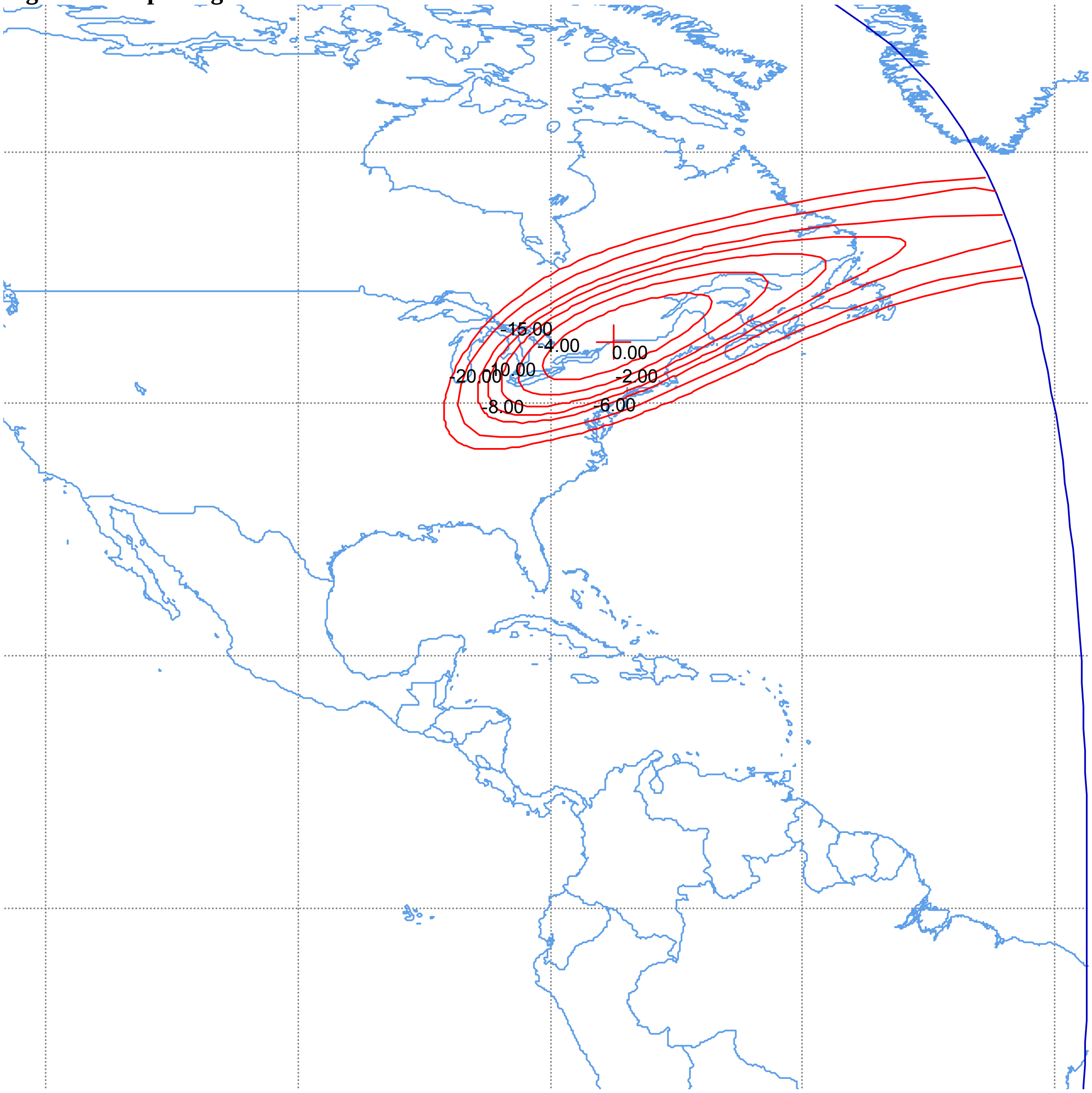


Figure 3: Co-polar gain contours for beam STXL

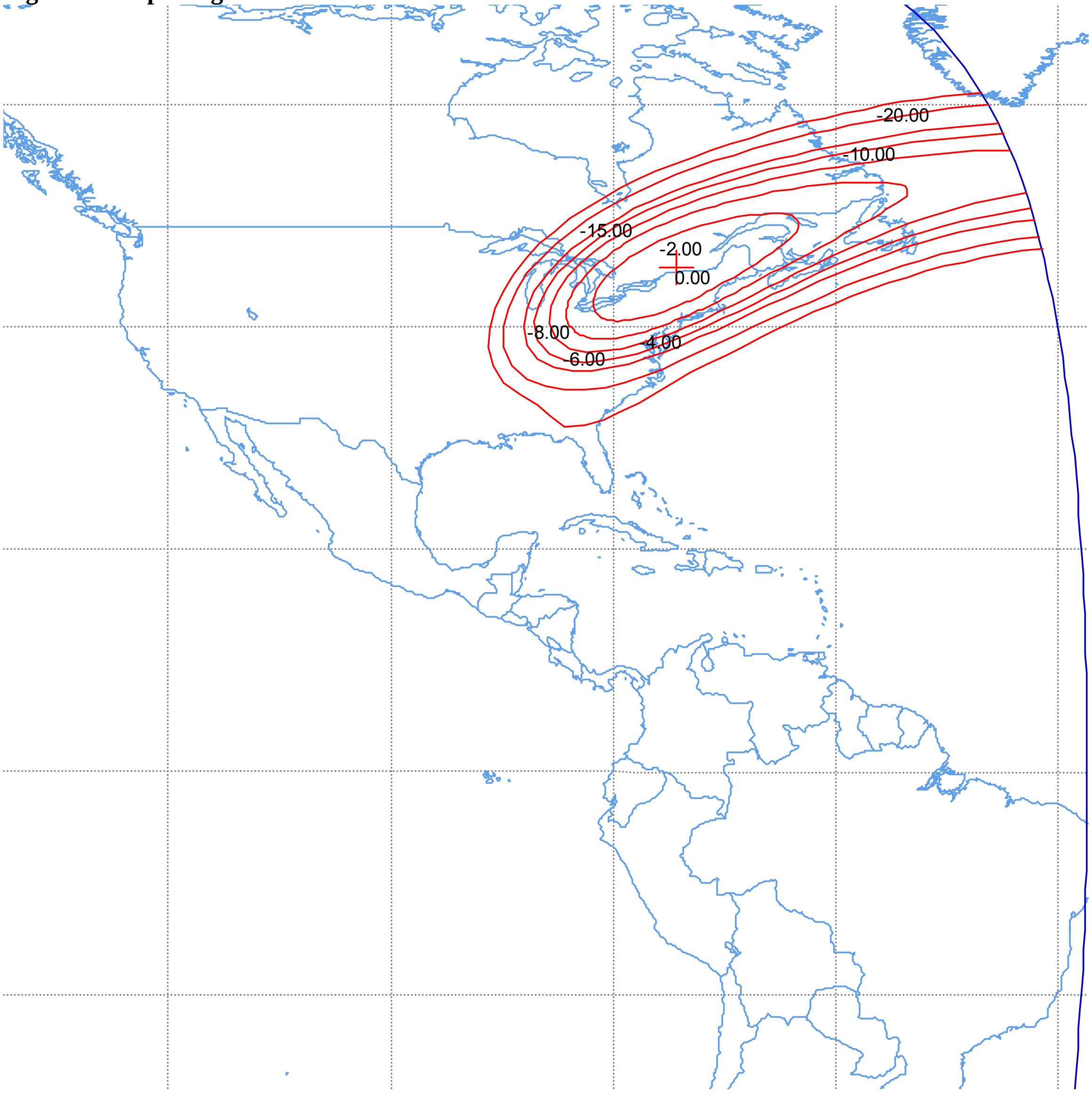


Figure 4: Co-polar gain contours for beam WRXL

Figure 5: Co-polar gain contours for beam WRXR

Figure 6: Co-polar gain contours for beam WTXL

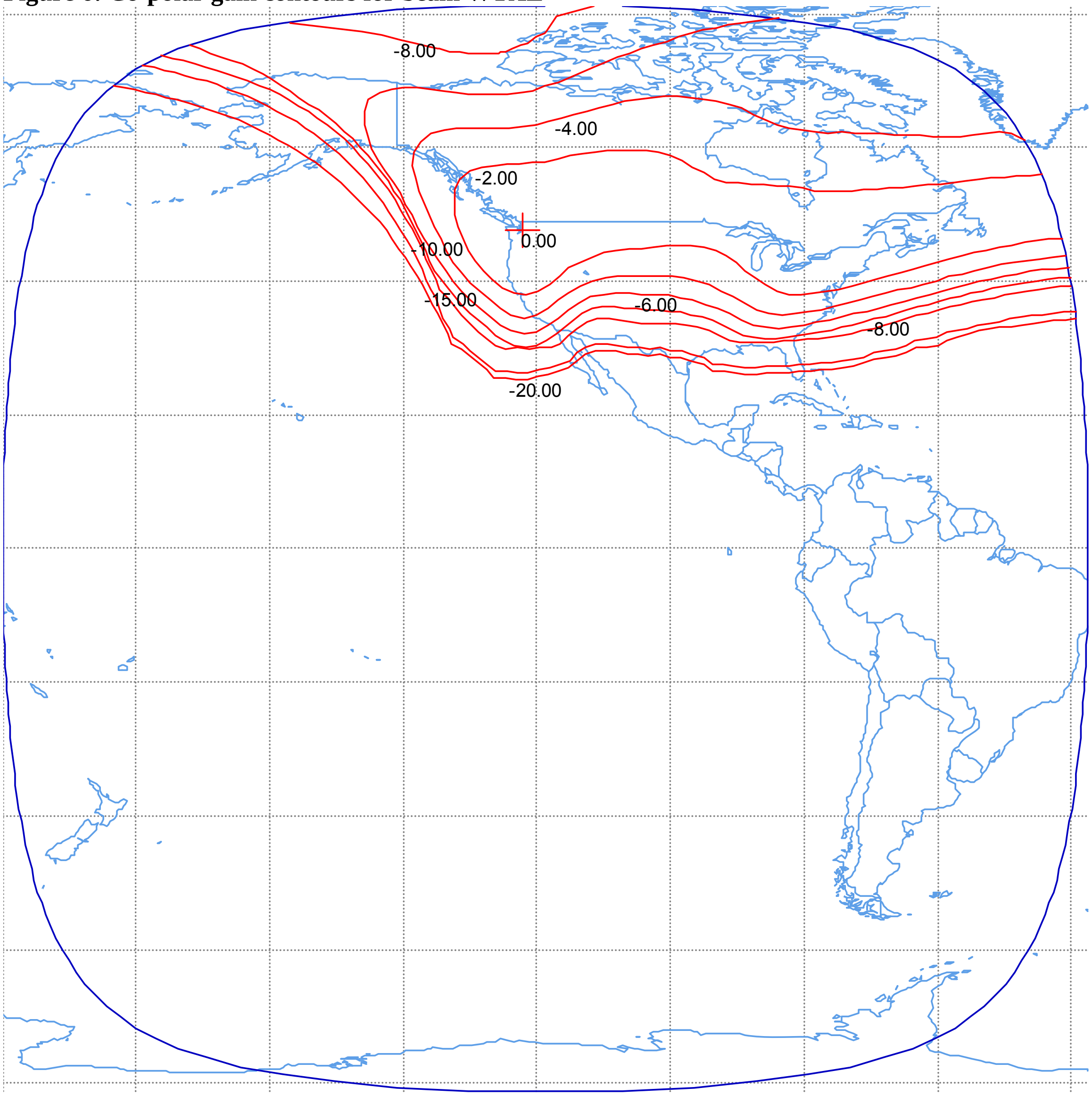
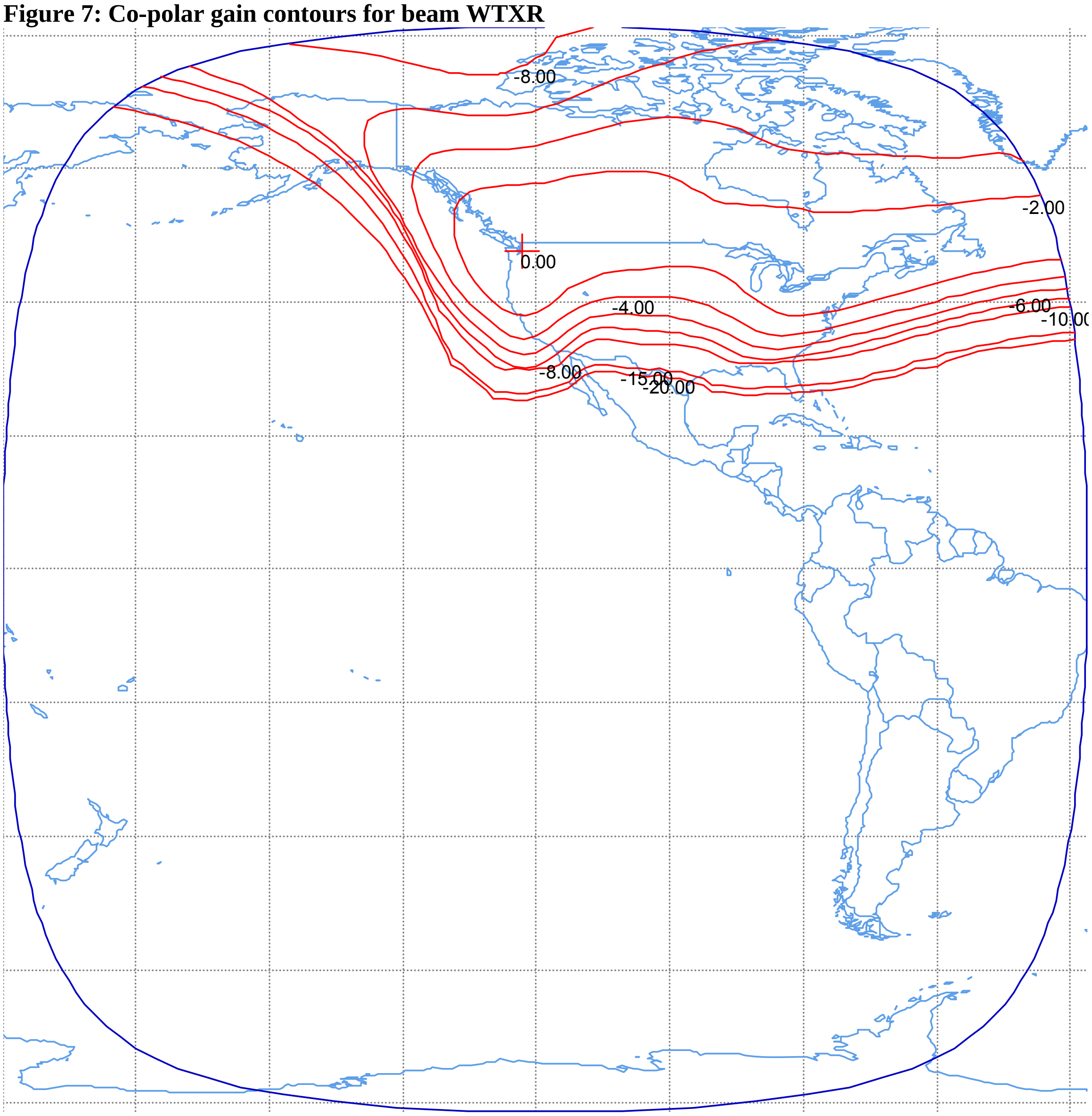


Figure 7: Co-polar gain contours for beam WTXR



Annex 2

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 adjacent satellite interference (ASI) are presented and it is shown how the uplink and downlink C/I values of Table 8 and Table 9 have been computed.

As mentioned earlier, there is currently no authorized or proposed geostationary satellite within two degrees of Anik F3 in the Ka band frequencies of Anik F3. In the analysis below the C/I which would be caused by potential future satellites two degrees away from Anik F3 is calculated. It is assumed that those future satellites would have downlink EIRP and uplink power levels similar to those of the Anik F3 satellite network.

In the following, an antenna diameter of 0.66m has been considered for the earth station of the Anik F3 satellite network, and uplink and downlink C/I due to ASI from adjacent satellites at ±2° and ±4° away from Anik F3 are calculated. The same procedure has been used for the calculation of ASI for other earth station antenna sizes (i.e., 1m and 8m).

Table 10 shows the calculation details of the uplink C/I due to ASI from an adjacent satellite 2° away from Anik F3. Table 11 shows the calculation details of the uplink C/I due to ASI from an adjacent satellite 4° away from Anik F3. Table 12 shows the calculation of the aggregate uplink ASI from adjacent satellites at ±2° and ±4° away from Anik F3.

The calculation details for downlink C/I due to ASI from an adjacent satellite 2° away from Anik F3 is shown in Table 13. The calculation details for downlink C/I due to ASI from an adjacent satellite 4° away from Anik F3 is shown in Table 14. The calculation of the aggregate downlink ASI from adjacent satellites at ±2° and ±4° away from Anik F3 is shown in Table 15.

Table 10: Calculation of the uplink C/I for an earth station antenna size of 0.66m due to ASI from an adjacent satellite network 2° away

Anik F3 Orbital Location	Deg WL	118.7
Adjacent Satellite Location at 2 degrees away	Deg WL	120.7
Station Keeping Tolerance	Deg	0.05
Minimum Geocentric Effective Separation	Deg	1.9
Topocentric Separation (θ)	Deg	2.09
Uplink ASI C/I Calculation		
Frequency	GHz	29.65
Anik F3 TX Earth Station		
Antenna Diameter	m	0.66
Antenna Gain	dBi	44.4
Adjacent Satellite Network TX Earth Station		
Antenna Off-axis gain toward Anik F3 (29-25log(θ))	dBi	21.0
C/I (Uplink ASI)	dB	23.4

Table 11: Calculation of the uplink C/I for an earth station antenna size of 0.66m due to ASI from an adjacent satellite network 4° away

Anik F3 Orbital Location	Deg WL	118.7
Adjacent Satellite Location at 4 degrees away	Deg WL	122.7
Station Keeping Tolerance	Deg	0.05
Minimum Geocentric Effective Separation	Deg	3.9
Topocentric Separation (θ)	Deg	4.29
Uplink ASI C/I Calculation		
Frequency	GHz	29.65
Anik F3 TX Earth Station		
Antenna Diameter	m	0.66
Antenna Gain	dBi	44.4
Adjacent Satellite Network TX Earth Station		
Antenna Off-axis gain toward Anik F3 (29-25log(θ))	dBi	13.2
C/I (Uplink ASI)	dB	31.2

Table 12: Aggregate uplink ASI from adjacent satellites at +/- 2 and +/- 4 degrees away

Uplink C/I due to ASI from the adjacent satellite +2 degrees away	dB	23.4
Uplink C/I due to ASI from the adjacent satellite -2 degrees away	dB	23.4
Uplink C/I due to ASI from the adjacent satellite +4 degrees away	dB	31.2
Uplink C/I due to ASI from the adjacent satellite -4 degrees away	dB	31.2
Aggregate Uplink C/I due to ASI	**dB**	**19.7**

Table 13: Calculation of the downlink C/I for an earth station antenna size of 0.66m due to ASI from an adjacent satellite network 2° away

Anik F3 Orbital Location	Deg WL	118.7
Adjacent Satellite Location at 2 degrees away	Deg WL	120.7
Station Keeping Tolerance	Deg	0.05
Minimum Geocentric Effective Separation	Deg	1.9
Topocentric Separation (θ)	Deg	2.09
Downlink ASI C/I Calculation		
Frequency	GHz	19.95
Anik F3 RX Earth Station		
Antenna Diameter	m	0.66
Antenna Gain	dBi	40.9
Antenna Off-axis gain toward Adjacent Sastellite (29-25log(θ))	dBi	21.0
C/I (Downlink ASI)	dB	19.9

Table 14: Calculation of the downlink C/I for an earth station antenna size of 0.66m due to ASI from an adjacent satellite network 4° away

Anik F3 Orbital Location	Deg WL	118.7
Adjacent Satellite Location at 4 degrees away	Deg WL	122.7
Station Keeping Tolerance	Deg	0.05
Minimum Geocentric Effective Separation	Deg	3.9
Topocentric Separation (θ)	Deg	4.29
Downlink ASI C/I Calculation		
Frequency	GHz	19.95
Anik F3 RX Earth Station		
Antenna Diameter	m	0.66
Antenna Gain	dBi	40.9
Antenna Off-axis gain toward Adjacent Sastellite (29-25log(θ))	dBi	13.2
C/I (Downlink ASI)	dB	27.7

Table 15: Aggregate downlink ASI from adjacent satellites at +/- 2 and +/- 4 degrees away

Downlink C/I due to ASI from the adjacent satellite +2 degrees away	dB	19.9
Downlink C/I due to ASI from the adjacent satellite -2 degrees away	dB	19.9
Downlink C/I due to ASI from the adjacent satellite +4 degrees away	dB	27.7
Downlink C/I due to ASI from the adjacent satellite -4 degrees away	dB	27.7
Aggregate Downlink C/I due to ASI	**dB**	**16.2**

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.

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