Engineering Statement

1) Introduction

Intelsat License LLC ("Intelsat") seeks authority in this application to launch and operate a new satellite designated as Intelsat 31. This spacecraft will operate from 95.05° W.L. and will operate in conjunction with Intelsat 30, for which there is a pending application for license to operate at 95.05° W.L. (see FCC File No.: SAT-AMD-20121221-00220)[1]. The characteristics of the Intelsat 31 spacecraft, as well as its compliance with the various provisions of Part 25 of the Commission's rules, are provided in the remainder of this Engineering Statement.

2) Spacecraft Overview

Intelsat 31 is a Space Systems Loral model SS/L 1300E spacecraft that operates on the C-band frequencies of 6425 – 6725 MHz, 3400 – 3700 MHz; and Ku-band frequencies of 13750 – 14500 MHz, 10950 – 11200 MHz, 11450 – 11700 MHz and 11700 – 12200 MHz. The spacecraft utilizes four C-band channels to provide global service and 73 Ku-band channels to provide service to southwest coast of the United States, South America excluding Brazil, and a portion of the Caribbean.

2.1) Structure

Intelsat 31 is a three-axis stabilized type spacecraft that has a rectangular outer body structure. Internally, the spacecraft is comprised of a central cylinder to which a number of panels are attached. Intelsat 31 utilizes two six-panel deployable solar array wings and four deployable antennas.

The structural design of Intelsat 31 provides mechanical support for all subsystems. The structure externally supports the communication antennas, solar arrays, and the thrusters. It also provides a stable platform for preserving the alignment of critical elements of the spacecraft.

A summary of the basic spacecraft characteristics is provided in Exhibit 1. The Intelsat 31 mass budget is provided in Exhibit 2.

[1] Galaxy 3C also operates at 95.05° W.L (see FCC File Number: SAT-MOD-20060303-00019); however, it is expected that this spacecraft will be relocated to another orbital location upon the arrival of Intelsat 31.

2.2) Thermal Subsystem

Thermal control is accomplished through the use of thermal control coatings, blankets, shields, heaters, heat pipes, special paint/coating and heat rejection surfaces. Heat pipes are embedded in a number of key equipment panels. High thermal dissipation components are located directly on the north and south communication panels. Optical Solar Reflectors ("OSRs") are used on the outer faces of these panels as well as a portion of the east-west panels. Multilayer Insulation ("MLI") blankets are used on the external east, west, nadir and aft surfaces of the spacecraft.

A number of the traveling wave tube amplifiers ("TWTAs") of the Ku-band communication subsystem are equipped with radiators protruding from the spacecraft body which radiate a large percentage of the TWTA heat directly to space. The TWTAs supporting the C-band communications subsystem as well as a number of the Ku-band TWTAs are conduction cooled via direct contact with the spacecraft panels and heat pipe network. Heaters are employed throughout the spacecraft in order to ensure that temperature variations of the bus and communication units are maintained within appropriate limits throughout the operational life of the satellite. Battery temperatures are maintained within limits through the combined use of heat pipes, heaters, blankets and OSRs.

2.3) Power Subsystem

The Electrical Power Subsystem ("EPS") generates, stores, conditions and protects the satellite's electrical power. It provides the energy required to operate the satellite during all modes of operation. The EPS consists of the solar array, batteries, associated power electronics, and power harnesses that integrate and regulate the systems.

Intelsat 31 utilizes two deployable solar array wings, with one wing located on the north side of the spacecraft and the other located on the south side of the spacecraft. Each solar wing is composed of six main panels. The panels support the requisite solar cells. During launch, the solar array wings are in the stowed position. However, during transfer orbit the solar wings are deployed, with each wing extending out on the north and south sides of the spacecraft. The solar array is designed to provide power to the spacecraft for at least 15 years.

During eclipse periods, the primary source of power to the spacecraft is through batteries. Intelsat 31 utilizes two 24-cell and two 22-cell Lithium ion batteries.

The Intelsat 31 EPS has been designed so that no single failure in the subsystem will cause a spacecraft failure. The EPS will provide sufficient power to the spacecraft throughout its design life to support all active communication channels as well as all necessary housekeeping loads. The beginning of life ("BOL") and end of life ("EOL") power budgets for Intelsat 31 are provided in Exhibit 3.

2.4) Attitude Control Subsystem

The Attitude Control Subsystem ("ACS") maintains the spacecraft attitude during the transfer orbit, initial acquisition period, and on-station geostationary operations. Additionally, the ACS is responsible for re-acquisition of the spacecraft in case of emergency and its placement into a safe configuration.

The ACS is composed of primary and redundant sun sensors, primary and redundant Earth sensors, 3-for-1 redundant gyros, 4-for-3 redundant reaction wheels, bi-propellant thrusters, electric thrusters and associated electronics. Control of the spacecraft attitude and orientation is accomplished through the use of reaction wheels, pulsed or continuous firing of selected bi-propellant and/or stationary plasma thrusters by the ACS.

2.5) Propulsion Subsystem

The propulsion subsystem provides impulse for the spacecraft maneuvering during all phases of the mission beginning with launch vehicle separation through the operational lifetime of the satellite. The spacecraft utilizes both chemical propulsion as well as electric propulsion systems. The major components of the propulsion subsystem are as follows: 1) two high pressure helium tanks, 2) one fuel tank, 3) one oxidizer tank, 4) a single 455-N thruster, 5) twelve 22-N bi-propellant thrusters, 6) associated pressure regulators, filters, flow control components, and pressure transducers, 7) Xenon gas tank, 8) two sets of 2-for-1 redundant Stationary Plasma Thrusters, 9) four sets of 2-for-1 redundant Xenon Flow Controllers, 10) Xenon propellant storage and management assembly, and 11) electronics associates with the electric propulsion subsystem.

The non-electric (i.e., bipropellant) system utilizes a combination of Nitrogen Tetroxide and Hydrazine as propellants. The system utilizes Helium gas to pressurize the propellant tanks.

During transfer orbit operations, the bi-propellant propulsion system will be utilized. During normal on-station operations, both the electric and bi-propellant propulsion systems will be utilized.

The architecture of the dual mode systems are based on a low risk approach with many of the units having been flight proven. The system utilizes space qualified components and incorporates full redundancy for all critical components.

2.6) Communication Subsystem

2.6.1) Overview

Intelsat 31 provides four active communication channels at C-band frequencies and 73 active channels at Ku-band frequencies. The C-band payload employs channels having a bandwidth of 69.6 MHz. The Ku-band payload employs channels having bandwidths of 8, 24 and 36 MHz. The Intelsat 31 frequency and polarization plans are provided in Exhibit 4.

At C-band, the Intelsat 31 receive and transmit beams provide global coverage. At Ku-band, the spacecraft provides coverage of southwest coast of the United States, South America excluding Brazil, and a portion of the Caribbean.

At Ku-band frequencies, Intelsat 31 employs full frequency reuse through the use of orthogonal polarization within the same beam and/or through the use of spatially isolated beams. Accordingly, Intelsat 31 is compliant with Section 25.210(f) of the Commission's rules.

At C-band, Intelsat 31 utilizes only one polarization with its uplink and downlink frequency beams; hence, it is not compliant with the provisions of Section 25.210(f). However, as explained in the legal narrative, the beam polarization utilized by Intelsat 31 is complementary to that which is proposed for use by its sister satellite, Intelsat 30. When considered in tandem, Intelsat 30 and Intelsat 31will employ full frequency reuse and are thus compliant with the provisions of Section 25.210(f) of the Commission's rules. Although, based on the foregoing, a waiver does not seem to be required, out of an abundance of caution, Intelsat requests a waiver of Section 25.210(f) of the rules should the Commission determine otherwise.

With respect to the use of the 10950 – 11200 MHz band, Section 25.202(a)(1) of the rules and footnote NG 52 of the United States Table of Frequency Allocations, as contained in Section 2.106 of the Commission's rules, permits the use of this band by non-federal fixed satellite service for international systems only. Intelsat 31 utilizes the 10950 – 11200 MHz band with the Region 1, 2, 3 and 4 downlink beams. Only the Region 1 beam provides coverage of U.S. territory. However, the Intelsat 31 uplink beams that can be connected to the Region 1 downlink beam provide coverage to areas outside of the United States. Accordingly, Intelsat 31 is compliant with the provisions of NG 52 and Section 25.202(a)(1).

With respect to the use of the 11450 – 11700 MHz band, Section 25.202(a)(1) of the rules and footnote NG 52 of the United States Table of Frequency Allocations, as contained in Section 2.106 of the Commission's rules, permits the use of this band by non-federal fixed satellite service for international systems only. Intelsat requests authorization to operate domestic systems in this band on a non-interference/non-protected basis and therefore seeks a waiver of NG 52 and Section 25.202(a)(1).

Specifically, the Intelsat 31's Pan Regional downlink beam in the 11450 – 11700 MHz band provides service to Puerto Rico. Additionally, the CBC downlink beam operates in this band and provides service the southwest coast of the United States. The Pan Regional downlink beam may be accessed through the CBC or TCN uplink beams. The CBC downlink beam may be accessed through the TCN uplink beam. Any transmission in the 11450 – 11700 MHz band that utilizes the aforementioned uplink/downlink beam pairs may not be fully compliant with NG 52, since these beams provide coverage of small areas within the United States or its territories; and there is a possibility the uplink transmissions may originate from the United States or its territories and terminate in Puerto Rico or the southwest coast of the United States.

One of the reasons behind the adoption of NG 52 was to limit the proliferation of earth stations operating in this band. However, the Intelsat 31 Pan Regional and CBC downlink beams provide coverage of a very limited area of US territory. Moreover, the services to be carried on these beams will require a very limited number of earth stations to be located on land mass. Hence, the risk of earth stations operating in this band and proliferating within the United States or its territories is quite limited.

Accordingly, the Intelsat believes that a waiver of the provisions of Section 25.202(a)(1) and of footnote NG 52 of Section 2.106 is justified.

The United States Table of Frequency Allocations, contained in Section 2.106 of the Commission's Rules, limits the use of the 3400 – 3500 MHz band to Federal systems operating in the Radiolocation service. The use of the 3500 – 3600 MHz band is limited to Federal Radiolocation and Federal Aeronautical Radionavigation Service. Concerning the operation of Intelsat 31 in the 3400 – 3600 MHz band, Intelsat shall not cause interference to nor claim protection from any system(s) authorized by the Commission to operate in this band.

With respect to the use of the 3600 - 3650 MHz band, the United States Table of Frequency Allocations, contained in Section 2.106 of the Commission's rules, permits the use of this band by non-federal fixed satellite service for international and intercontinental systems only (see note US 245). Intelsat will comply with the provisions of US 245.

With respect to the use of the 3650 – 3700 MHz band, the United States Table of Frequency Allocations, contained in Section 2.106 of the Commission's rules, states that after December 1, 2000 operations of the fixed satellite service shall be secondary within the United States (see note NG 169). Additionally, note NG 185 states that the use of the 3650 – 3700 MHz band by non-Federal fixed satellite service is limited to international and intercontinental systems. Intelsat acknowledges and shall comply with the provisions of NG 169 and NG 185.

With respect to the use of 13750 – 14000 MHz band, footnotes US 356 and US 357 of the United States Table of Frequency Allocations, contained in Section 2.106 of the Commission's rules, place a number of technical constraints on the operation of Earth stations and their associated emissions. Intelsat shall comply with the provisions of footnotes US 356 and US 357.

2.6.2) <u>Antennas and Beam Coverage</u>

At C-band, Intelsat 31 utilizes a C-band global horn receive antenna and a global horn transmit antenna. At Ku-band, Intelsat utilizes one global horn receive antenna, one global horn transmit antenna, four single feed deployable transmit reflector antennas, one fixed single feed transmit antenna, one fixed multi-feed transmit/receive reflector antenna. The coverage beams of the Intelsat 31 antennas are shown in Exhibits 5A-1 through 5A-25, in the format prescribed in Section 25.114(d)(3) of the Commission's rules.

The performance characteristics for each beam are also provided in Exhibits 5A-1 through 5A-25. For the uplink beams, the SFD at any G/T contour may be determined using the following formula:

$$SFD_D = SFD_P + [(G/T)_P - (G/T)_D] + A$$

where

SFD_D: SFD at desired G/T level (dBW/m^2)
SFD_P: Minimum SFD at peak G/T (dBW/m^2)
$(G/T)_D$: Desired G/T level (dB/K)
$(G/T)_P$: Peak G/T (dB/K)
A = Transponder attenuator setting (dB), ranging from 0 to 21 dB adjustable in 1 dB increments at C-band, and from 0 to 20 dB adjustable in 1 dB increments at Ku-band

Accordingly, Intelsat 31 is compliant with the provisions of Section 25.210(c) of the rules.

Exhibit 6 provides a detailed calculation of the EIRP, G/T and SFD of the Intelsat 31 uplink and downlink beams.

The Intelsat 31 beams are designed to comply with the antenna cross-polarization requirement of Section 25.210(i)(1) of the Commission's rules.

2.6.3) Transponder description

2.6.3.1) C-Band

The output of the C-band receive antenna is fed to an input test coupler and then to a preselect filter that is designed to further reject the transmit frequency band and other undesired signals and prevent the overloading of the receive section. The output of the preselect filter is connected to a 2-for-1 redundant receiver. The Intelsat 31 C-band receivers are able to maintain over the life of the spacecraft the frequency of the transmitted (down converted) signal to within +/- 0.002% of the desired value. Accordingly, Intelsat 31 is compliant with Section 25.202(e) of the Commission's rules.

The output of the receiver is routed to a hybrid and then to a bank of Input Multiplexers (“IMUXs”). The IMUXs are filters that provide frequency band separation for each channel.

The output of each IMUX channel is connected to a corresponding Linearized Channel Amplifier / Traveling Tube Amplifier (“LCAMP/TWTA”) pair through a redundancy switching network. The switching network allows for the output of each IMUX to be routed to a redundant LCAMP/TWTA should the primary unit fail.

The LCAMP/TWTAs are configured in a 6-for-4 redundancy ring. Each LCAMP/TWTA is comprised of an LCAMP that feeds a 65 Watt, conduction cooled, C-band TWTA.

The LCAMP provides high gain, and amplitude and gain expansion to compensate for the selected TWTA. The LCAMP may only be operated in the Fixed Gain Mode (“FGM”), whereby the output of the LCAMP may be adjusted by ground command from 0 to 21 dB in 1dB increments. Accordingly, Intelsat 31 is compliant with the provisions of Section 25.210(c) of the Commission’s rules.

The output of each LCAMP/TWTA is then routed through a bank of switches to an Output Multiplexer (“OMUX”). The switching network allows the output of a redundant LCAMP/TWTA to be forwarded to the appropriate OMUX should the primary LCAMP/TWTA unit fail.

The output of OMUX is fed in succession to a high pass filter, a test coupler and the antenna feed for transmission to Earth.

2.6.3.2) <u>Ku-Band</u>

With the exception of the TCN beam antenna the output of each Ku-band (receive) antenna is divided into its polarization specific receive signal components through the use of an OMT. The signal is then fed to an input test coupler, a preselect filter that is designed to reject the transmit frequency band and other undesired signals, and prevent overloading of the receive section.

For the TCN beam, the signal is received by an antenna that is also used to receive the spacecraft command signals (see section 2.7.1). The received signal is sent directly to the test coupler and then to the preselect filter.

The output of the preselect reject filters are connected to an LNA through a redundancy switch ring. The Intelsat 31 Ku-band LNAs are organized in one 9-for-7 redundant ring and one 6-for-4 redundant ring.

The signal is then routed to a set of frequency down-converters that converts the uplink frequency to the appropriate downlink frequency. Intelsat 31 utilizes a bank of 7-for-4 redundant Ku-band down-converters having a translation frequency of 2289.5 MHz, one bank of 12-for-8 redundant Ku-band down-converters that has a translation frequency of 2300 MHz, one bank of 7-for-4 redundant Ku-band down-converters that has a translation frequency of 2806 MHz, one bank of 7-for-4 redundant Ku-band down-converters that has translation frequency of 3300 MHz and one bank of 2-for-1 redundant Ku-band down-converters that has translation frequency of 3035 MHz. The Intelsat 31 Ku-band frequency down-converters are able to maintain over the life of the spacecraft the frequency of the transmitted (down converted) signal to within +/- 0.002% of the desired value. Accordingly, Intelsat 31 is compliant with Section 25.202(e) of the Commission's rules.

The output of each frequency down-converter is routed to hybrid signal dividers, which then feed the individual IMUXs. The IMUX is a filter that provides frequency band separation for each channel. The output of each IMUX channel is connected to a corresponding ("Linearized Channel Amplifier") LCAMP/TWTA or ("Limiter Channel Amplifier") LimCAMP/TWTA pair.

Intelsat 31 utilizes 70 Watt conduction cooled TWTAs, 95 Watt conduction cooled TWTAs, 95 Watt radiation cooled TWTAs, 120 Watt radiation cooled Ku-band TWTAs, 148 Watt radiation cooled TWTAs and 150 Watt radiation cooled TWTAs. Intelsat 31 utilizes LimCAMPs for all of the 70 Watt TWTAs, the 120 Watt TWTAs, the 148 Watt TWTAs, the 150 W TWTAs. With regard to the 95 Watt TWTAs, Intelsat 31 utilizes both LCAMPs and LimCAMPs, whereby LCAMPs are used only for the TCN channels.

The 70 Watt LimCAMP/TWTAs are arranged in two 8-for-6 redundancy rings, the 95 Watt LCAMP/TWTAs are arranged in one 2-for-1 redundancy configuration, the 95 Watt LimCAMP/TWTAs are arranged in two 8-for-6 redundancy rings, the 120 Watt LimCAMP/TWTAs are arranged in two 8-for-6 redundancy rings, the 148 Watt LimCAMP/TWTAs are arranged in one 18-for-8 redundancy ring and one 22-for-16 redundancy ring, and the 150 Watt LimCAMP/TWTAs are arranged in two 8-for-6 redundancy rings.

The LCAMP provides high gain, and amplitude and gain expansion to compensate for the selected TWTA. The LCAMP may be operated in the Fixed Gain Mode ("FGM") or in the Automatic Level Control ("ALC") mode. In the FGM mode, the output of the LCAMP may be adjusted by ground command from 0 to 20 dB in 1 dB increments. Accordingly, Intelsat 31 is compliant with the provisions of Section 25.210(c) of the Commission's rules. In the ALC mode, the LCAMP automatically adjusts its gain depending on the power level of the input signal in order to maintain a constant output power in the presence of varying uplink power. When operating in the ALC mode, the amplifier output power may be selected (by ground command) within a minimum range of 7 dB in 0.5 dB steps.

The LimCAMP provides high gain amplification and a limiting function for the selected TWTA. The LimCAMP may be operated in the FGM or in the ALC mode. In the FGM mode, the output of the LimCAMP may be adjusted by ground command from 0 to at least 20 dB in 1 dB increments. Accordingly, Intelsat 31 is compliant with the provisions of Section 25.210(c) of the Commission's rules. In the ALC mode, the LimCAMP automatically adjusts its gain depending on the power level of the input signal in order to maintain a constant output power in the presence of varying uplink power. When operating in the ALC mode, the amplifier output power may be selected (by ground command) within a minimum range of 16 dB in 0.5 dB steps**.**

With the exception of the TCN channel, the output of each LimCAMP/TWTA or LCAMP/TWTA, as the case may be, is routed to a switch bank which permits connection of the channel to the appropriate OMUX (and downlink beam). The output of each OMUX is fed to a test coupler, and then to the antenna feed for transmission to Earth.

For the TCN channel, the output of each LCAMP/TWTA is sent to a directional coupler before being routed to the appropriate OMUX.

It is noted that a number of channels may be operated in a high power mode, whereby the output of two TWTAs are combined. The specific Intelsat 31 channels that can operate in a high power mode have been identified in Exhibit 4B.

2.7) Telemetry, Command and Ranging Subsystem

The telemetry, command and ranging (TC&R") subsystem provides the following functions:

1) Acquisition, processing and transmission of spacecraft telemetry data;
2) Reception and retransmission of ground station generated ranging signals; and
3) Reception, processing and distribution of telecommands.

The TC&R subsystem consists of the following elements: 1) two circularly polarized omni-directional command antennas located on the nadir side of the spacecraft (referred to as the +Z command antennas), 2) two circularly polarized omni-directional command antennas located on the aft side of the spacecraft (referred to as the –Z command antennas), 3) two circularly polarized omni-directional telemetry antenna located on the nadir side of the spacecraft (referred to as the +Z telemetry antennas), 4) two circularly polarized omni-directional telemetry antennas located on the aft side of the spacecraft (referred to as the –Z telemetry antennas), 5) one linearly polarized global horn command antenna, 6) one linearly polarized global horn telemetry antenna, 7) one dual frequency command receiver, 8) two single frequency command receivers, 9) two dual frequency telemetry transmitters, 10) two 35 Watt TWTAs, 11) baseband digital data handling system, and 12) microwave components including filters, switches, couplers, isolators, cables and waveguide.

2.7.1) Antennas

The coverage patterns of the command and telemetry beams are provided in Exhibits 5B-1 through 5B-6, in the format prescribed in Section 25.114(d)(3) of the Commission's rules. When on-station, command and telemetry signals are received and transmitted through the global horn antennas. The global horn command antenna is also used to receive the TCN channel transmissions (see section 2.6.3.2). During emergencies and transfer orbit operations, the +Z and –Z antennas are utilized for command and telemetry.

2.7.2) Command

The Intelsat 31 command subsystem performance summary is provided in Exhibit 7. Detailed calculation of the G/T and command threshold flux density for each command beam is provided in Exhibit 8.

During on-station operations, commands are sent to the spacecraft by transmission of two independent FM signals on the frequencies of 13998.5 MHz and 14006.0 MHz. The command signals are routed to three command receivers. The receivers amplify and demodulate the signal, and convert the command signal into a digital stream. The output of the command receivers are forwarded to baseband data handling system, where the commands are decoded and sent to the appropriate unit.

Intelsat 31 utilizes two single frequency command receivers and one dual frequency command receiver. The latter type receiver can operate on one of the two command frequencies, as selected by ground command.

During transfer orbit and emergency operations, the operation of the command subsystem is similar to that for on-station operations, except that the transmitted command signals are received by the +Z and -Z antennas.

2.7.3) Telemetry

The Intelsat 31 telemetry subsystem performance summary is provided in Exhibit 7. Detailed calculation of the EIRP for each telemetry beam is provided in Exhibit 8.

Telemetry is transmitted by the spacecraft on two independent, PM signals. Each telemetry signal may be transmitted on a frequency that is selectable from the following frequency pairs: 11194.25 / 11195.5 MHz or 11196.25 / 11196.75 MHz. The telemetry frequencies are compliant with the provisions of Section 25.202(g) of the Commission's rules. The telemetry baseband functions are implemented in the baseband data handling system, where data from the various spacecraft units are collected, processed, multiplexed, formatted and encoded onto subcarriers. The output of the baseband data handling system is routed to the telemetry transmitters where the signal is modulated onto the main carrier frequencies.

Intelsat 31 utilizes two dual frequency transmitters. One transmitter can operate on the frequencies of 11194.25 MHz or 11195.5 MHz; and the other transmitter can operate at 11196.25 MHz or 11196.75 MHz. The telemetry transmitters are able to maintain the downlink transmit frequency to within +/- 0.002% of the desired frequency over the life of the spacecraft. Accordingly, Intelsat 31 telemetry is compliant with Section 25.202(e) of the rules.

Each telemetry transmitter has a low power output port and a high power output port. The low power transmitter output routes the signal to a 35 Watt TWTA for higher power operation during emergency operations.

During on-station operations, the signal from the high power output signal of each telemetry transmitter is routed to the global horn antenna for transmission back to Earth. During emergency operations, the low power output signal of each telemetry transmitter is sent, in succession, to a 35 Watt TWTA, a directional coupler and then to the +Z and –Z antennas for transmission back to Earth.

2.7.4) Ranging

During all phases of the mission, the slant range of the spacecraft can be determined to a relatively high level of accuracy through the use of a multiple tone ranging system. The ranging tones selected are combined with the normal command data and modulated onto the command carrier and transmitted to the spacecraft. Once received by the spacecraft through the appropriate receiving antenna, the signal is routed to the command receiver where it is separated from the normal command data and routed directly to the spacecraft's telemetry transmitter. At the telemetry transmitter, the ranging signal is combined with other telemetry data and modulated onto the main telemetry carrier and transmitted to Earth through the appropriate spacecraft transmitting antenna. On the ground, the ranging tones are separated from the telemetry data, demodulated and their phase compared with that of the transmitted signal to determine the range of the satellite.

Because the ranging subsystem uses the command and telemetry subsystems, the descriptions of the operation of these two latter systems during on-station, transfer orbit and emergency conditions are applicable to the ranging subsystem as well. The performance summary of the Intelsat 31 command, telemetry and ranging subsystems are provided in Exhibit 7.

2.7.5) Arrangement For Telemetry, Tracking and Control

Intelsat will conduct TC&R operations through earth stations located at one or more of the following locations: Castle Rock, Colorado; Filmore, California; Riverside, California; Napa, California; and Mountainside, Maryland. Additionally, Intelsat is capable of remotely controlling Intelsat 31 from its facility in Washington D.C.

2.8) Uplink Power Control Subsystem ("ULPC")

2.8.1 Antennas

Intelsat 31 utilizes a dedicated global horn antenna to generate the Ku-band global ULPC beams. The coverage patterns of the Ku-band ULPC beams are provided in Exhibits 5C-1 and 5C-2.

2.8.2 ULPC System Description

Intelsat 31 provides two Ku-band beacon signals that can be used for uplink power control by customers transmitting to the spacecraft. The Ku-Band ULPC beacons are circularly polarized and operate on the frequencies of 11705.5 MHz and 11193.0 MHz. Detailed calculation of the EIRP for each ULPC beam is provided in Exhibit 6.

The Intelsat 31 Ku-band ULPC beacon transmitters are able to maintain the downlink transmit frequency to within +/- 0.002% of the desired frequency over the life of the spacecraft. Accordingly, Intelsat 31 is compliant with the provisions of Section 25.202(e) of the Commission's rules.

For the generation of each Ku-band ULPC frequency, dedicated 2-for-1 redundant transmitters are utilized. The output of each transmitter is directed to a test coupler, an OMT and then to the Ku-band global horn antenna for transmission to Earth.

2.9) Satellite Station-Keeping

The spacecraft will be maintained within 0.05° of its nominal longitudinal position in the east-west direction. Accordingly, it is in compliance with Section 25.210(j) of the Commission's rules.

The attitude of the spacecraft will be maintained with accuracy consistent with the achievement of the specified communications performance, after taking into account all error sources (i.e., attitude perturbations, thermal distortions, misalignments, orbital tolerances and thruster perturbations).

2.10) Satellite Useful Lifetime

The design lifetime of the satellite in orbit is 15 years. This has been determined by a conservative evaluation of the effect of the synchronous orbit environment on the solar array, the amount of fuel aboard the spacecraft, the effect of the charge-discharge cycling on the life of the battery, and the wear-out of the amplifiers and other active units. The mass allocation of propellant for spacecraft station keeping is 15 years. To enhance the probability of survival, equipment/unit redundancy is incorporated into the spacecraft design where possible. Materials and processes have been selected so that aging or wearing effects will not adversely affect spacecraft performance over the estimated life.

2.11) Spacecraft Reliability

Intelsat 31 is designed for an operational and mission life of 15 years. Life and reliability are maximized by incorporating flight proven or flight qualified units and designs to the greatest extent possible. All subsystems and units have a minimum design life of 15 years. Redundancy concepts are applied to all critical components. All avoidable single-point failure modes have been eliminated.

The projected reliability of the C- and Ku-band payloads is 81.4%. The projected reliability of the bus system is 86.0%. The overall reliability of the Intelsat 31 spacecraft is projected to be 70.0%. The subsystem reliability assessments were based upon the use of failure rates, modeling assumptions from previous spacecraft programs and those specific to Intelsat 31. Failure rates for spacecraft equipment have been calculated using actual electrical stress and operating temperature conditions for each part.

3.0) Services and Emission Designators

Intelsat 31 is to be a general purpose communications satellite and has been designed to support various services offered within Intelsat’s satellite system. Depending upon the needs of the users, the transponders on Intelsat 31 can accommodate television, radio, voice and data communications. Typical communication services to be offered at C-band include:

a) Frequency modulated television (TV/FM)

b) Compressed digital video

c) High speed digital data

d) Digital single channel per carrier ("SCPC") data channels

e) Digital SCPC with 64 kbps and T1 data rates

At Ku-band, the spacecraft is designed primarily to provide (digital) direct-to-home ("DTH") service.

Emission designators and allocated bandwidths for representative communication carriers are provided in Exhibit 9.

4.0) Power Flux Density ("PFD")

The power flux density ("PFD") limits for space stations operating in the 3650 – 4200 MHz, 10950 – 11200 MHz and 11450 – 11700 MHz bands are contained in Section 25.208 of the Commission's rules. With respect to the 3400 – 3650 MHz band, there are PFD limits specified in No. 21.16 of the ITU Radio Regulations. The ITU limits for this frequency band are identical to the FCC limits for the 3650 – 4200 MHz band. Neither the Commission's rules nor the ITU Radio Regulations specify any PFD limits for the 11700 – 12200 MHz band applicable to geostationary satellites operating in the fixed satellite service.

The maximum PFD levels for the Intelsat 31 transmissions were calculated for a number of TV/FM and/or digital carriers listed in Exhibit 9 operating in the 3400 – 3700 MHz, 10950 – 11200 MHz and 11450 – 11700 MHz bands. These carriers were chosen because they generally produce high PFD levels on the Earth's surface. The PFD levels were also calculated for the Intelsat 31 telemetry and ULPC carriers. The results are provided in Exhibit 10 and show that the downlink power flux density levels of the Intelsat 31 carriers do not exceed limits specified in Section 25.208 of the Commission's rules or in No. 21.16 of the ITU Radio Regulations.

5.0) Emission Limitations

The Intelsat 31 receiver and transmitter channel filter response characteristics are provided in Exhibit 11, as required under Section 25.114 (4)(vii) of the Commission's rules.

Intelsat will comply with the provisions of Section 25.202(f) of the Commission's rules with regard to Intelsat 31 emissions.

6.0) Service Area

At C-band, the primary service area of Intelsat 31 is the visible Earth, i.e., global coverage. At Ku-band, the primary service area is southwest coast of the United States, South America excluding Brazil, and a portion of the Caribbean.

7.0) Orbital Location

Intelsat requests that it be assigned the 95.05° W.L orbital location for Intelsat 31. The 95.05° W.L location satisfies Intelsat 31 requirements for optimizing coverage, elevation angles and service availability and ensures that maximum operational, economic and public interest benefits will be derived.

8.0) Orbital Arc Limitations

Intelsat 31 is intended to provide video, audio and data services to satellite users within its coverage area. The 95.05° W.L position affords reasonable earth station angles to the region. The attractiveness of Intelsat 31 to this market would be severely diminished if service to this area is not possible.

9.0) Intelsat 31 Link Budgets and Interference Analysis

Link analysis for Intelsat 31 was conducted for a number of representative carriers at C- and Ku-band frequencies. At C-band, it was assumed that the nearest satellites to Intelsat 31 were a hypothetical satellite operating at 93.05° W.L. and a hypothetical satellite operating at 97.05° W.L. The hypothetical satellites were assumed to have the same operational parameters as Intelsat 31.

At Ku-band, it was assumed that the nearest satellites to Intelsat 31 were a hypothetical satellite operating at 93.05° W.L. and a hypothetical satellite operating at 97.05° W.L.[2] The hypothetical satellites were assumed to have the same operational parameters as Intelsat 31.

[2] Galaxy 19 currently is licensed to Intelsat and operates at 97° W.L, providing coverage to the United States and the Caribbean in the 11.7 – 12.2 GHz frequency band (see FCC File Numbers: SAT-AMD-20060407-00040). Similarly, Galaxy 25 is licensed to Intelsat and operates at 93.1° W.L, providing coverage to the United States and the Caribbean in the 11.7 – 12.2 GHz frequency band (see FCC File Number: SAT-MOD-20120320-00057). The interference from Galaxy 19 and Galaxy 25 was not taken into account given the small coverage overlap between these spacecraft and Intelsat 31, which can be coordinated internally by Intelsat.

Other assumptions made for the link budget analysis were as follows:

a) In the plane of the geostationary satellite orbit, all transmitting and receiving earth station antennas have off-axis co-polar gains that are compliant with the limits specified in section 25.209(a)(1) of the FCC's rules.
b) All transmitting and receiving earth stations have a cross-polarization isolation value of at least 30 dB within their main beam lobe.
c) At C-band frequencies, degradation due to rain is not considered, given that rain (attenuation) effects are insignificant at C-band.
d) At Ku-band frequencies rain attenuation predictions are derived using Recommendation ITU-R P.618.
e) At Ku-band frequencies, increase in noise temperature of the receiving earth station due to rain is taken into account.
f) For the cases where the transponder operates in a multi-carrier mode, the effects due to intermodulation interference are taken into account.

The impact of the TV/FM carriers from the adjacent satellites located at 93.05° W.L. and 97.05° W.L on the transmissions of Intelsat 31 was not considered due to the fact that TV/FM carriers are known to be high-density carriers with most of the energy contained within the near vicinity of the carrier center frequency. Operation of sensitive narrow-band carriers is typically precluded within these high power density areas of the TV/FM carrier. Accordingly, placement and operation of TV/FM carriers are normally achieved through internal coordination and/or coordination discussions with the adjacent satellite operator, whichever may be the case, rather than through C/I calculations – since the results of such calculations would show that narrow-band carriers typically could not operate on a co-frequency basis with TV/FM carriers.

As shown in Exhibits 5A, the Ku-band beam performance of the Intelsat 31 receive beams are similar. In order to keep the number the Intelsat 31 link calculations to a manageable number, worst-case performance values were assumed for each Ku beam type. The worst-case beam parameters were derived from the beam parameters listed in Exhibit 5 and chosen in such a manner that would make carrier links utilizing any specific uplink / downlink beam combination as sensitive to adjacent satellite interference as possible. This would ensure that the link performance objectives would be achieved for all possible Intelsat 31 uplink and downlink beam combinations. The worst-case beam performance for each Intelsat 31 beam type is provided below:

Ku-band Beam Name	Aggregate Beam Designation	Worst-Case Beam Peak G/T (dB/K)	Worst-Case Beam SFD Range @ Peak G/T (dBW/m^2)	Worst-Case Beam EIRP (dBW)
ABC	Composite	15.3	-103.3 to -83.3	N/A
BBC				
CBC				
CoBC				
VBC				
Region 1	Composite	N/A	N/A	54.8
Region 2				
Region 3				
Region 4				

In order to keep the number the Intelsat 31 link calculations to a manageable number, with the exception of the TCN channel, all Ku-band link calculations were conducted at the single representative uplink frequency of 14125 MHz (that is midway between 13750 – 14500 MHz) and downlink frequency of 11575 MHz (that is approximately midway between 10950 MHz - 12200 MHz). The TCN channel link calculations were conducted at the uplink frequency of 14495 MHz and downlink frequency of 11460 MHz.

The results of the C-band and Ku-band analyses are shown in Exhibit 12 and demonstrate that operation of the Intelsat 31 satellite from 95.05º W.L. would permit the intended services to achieve their respective performance objectives while maintaining sufficient link margin. Additionally, the EIRP density levels of the carriers listed in Exhibit 12 comply with the FCC limits contained in section 25.212(c) and 25.212(d) of the Commission’s rules.

10.0) Adjacent Satellite Link Analysis

At C- and Ku-band, the impact of the proposed Intelsat 31 emissions on the transmissions of adjacent satellites located at 97.05° W.L and 93.05º W.L was analyzed.

At C-band, it was assumed that a hypothetical satellite having the same operating characteristics as Intelsat 31 occupied the orbital locations of 93.05° W.L and 97.05° W.L. For the satellite located at 93.05º W.L, it was assumed that the adjacent satellites were Intelsat 31, located at 95.05º W.L, and a hypothetical satellite having the same operating characteristics as

Intelsat 31 located at 91.05º W.L.[3] For the satellite located at 97.05º W.L, it was assumed that the adjacent satellites were Intelsat 31, located at 95.05º W.L, and a hypothetical satellite having the same operating characteristics as Intelsat 31 located at 99.05º W.L.

At Ku-band, it was assumed that a hypothetical satellite having the same operating characteristics as Intelsat 31 occupied the orbital locations of 93.05° W.L and 97.05° W.L. For the satellite located at 93.05º W.L, it was assumed that the adjacent satellites were Intelsat 31, located at 95.05º W.L, and a hypothetical satellite having the same operating characteristics as Intelsat 31 located at 91.05º W.L.[4] For the satellite located at 97.05º W.L, it was assumed that the adjacent satellites were Intelsat 31, located at 95.05º W.L, and a hypothetical satellite having the same operating characteristics as Intelsat 31 located at 99.05º W.L.[5]

The impact of Intelsat 31 emissions on the TV/FM carriers of the adjacent satellites at 93.05º W.L and 97.05º W.L was not considered for the reasons articulated in section 9.0 above. The assumptions made in section 9.0 pertaining to Earth station off-axis gain performance, Earth station cross-polarization performance and rain attenuation were also applied in the analysis.

The results of the analysis are given in Exhibits 13 and 14. The Intelsat 31 transmissions will be limited to those levels contained in Sections 25.212(c) and (d), as applicable, unless higher levels are coordinated with affected adjacent satellite operators. In any case, pursuant to the results in Exhibits 13 and 14, the uplink power density of the Intelsat 31 digital carriers operating in the 6425 – 6725 MHz and 13750 – 14500 MHz band will not exceed -38.7 dBW/Hz and -45 dBW/Hz, respectively. Within the 3400 – 3700 MHz band, the downlink EIRP density of the Intelsat 31 digital carriers

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[3] Brasilsat B3 is located at 92° W.L. and provides coverage of Brazil on the frequency bands of 5.85 – 6.425 GHz and 3.65 – 4.2 GHz. The operational status of this spacecraft is unknown. Brasilsat B3 was not considered in the C-Band analysis of the hypothetical 93.05º W.L satellite since the two satellites are separated only by 1.05º and would not effectively show the impact of adjacent satellite interference in a 2º environment.

[4] Galaxy 25 is licensed to Intelsat and operates at 93.1° W.L., providing coverage to the United States and the Caribbean in the 11.7 – 12.2 GHz frequency band (see FCC File Number: SAT-MOD-20120320-00057). In view of the small coverage overlap between Galaxy 25 and the hypothetical satellite at 93.05° W.L. and the small (0.05°) orbital separation between these spacecraft is inconsistent with a 2° orbital separation environment, the impact of Galaxy 25 transmissions was not considered.

[5] Galaxy 16 is licensed to Intelsat and operates at 99° W.L, providing coverage of the United States and a small portion of the Caribbean on the frequency band of 11.7 – 12.2 GHz (see FCC File Number: SAT-RPL-20051118-00233). For the 97.05° W.L. orbital location, the interference from Galaxy 16 was not considered given the small coverage overlap between Galaxy 16 and the hypothetical satellite at 97.05° W.L.

will not exceed -32 dBW/Hz. Within the 10950 – 11200 MHz and 11700 – 11948 MHz bands, the downlink EIRP density of the Intelsat 31 digital carriers will not exceed -16.5 dBW/Hz. Within the 11450 – 11700 MHz and 11948 – 12200 MHz bands, the downlink EIRP density will not exceed -13.8 dBW/Hz and -15.2 dBW/Hz, respectively.

11.0) Schedule S Submission

Intelsat is providing with its application a Schedule S for the operations of Intelsat 31 from 95.05º W.L. In column "g" of Section S13 of the Schedule S, a link budget file has been included for the first link (i.e., the first row of data) contained in that section. This link budget file is applicable to all the links listed in Section S13 and should have been included with each row of data in that section of the Schedule S. However, given that the link budget file is rather large and its inclusion with each link (or data row) would lead to the Schedule S file having an unmanageable size, all other links (or rows of data) contain a small ASCII file that references the link budget file that is attached to the first link (i.e., the link budget file attached to the first row of data).

12.0) Orbital Debris Mitigation Plan

Intelsat is proactive in ensuring safe operation and disposal of this and all spacecraft under its control. The four elements of debris mitigation are addressed below.

12.1) Spacecraft Hardware Design

The spacecraft is designed such that no debris will be released during normal operations. Intelsat has assessed the probability of collision with meteoroids and other small debris (<1 cm diameter) and has taken the following steps to limit the effects of such collisions: (1) critical spacecraft components are located inside the protective body of the spacecraft and properly shielded; and (2) all spacecraft subsystems have redundant components to ensure no single-point failures. The spacecraft does not use any subsystems for end-of-life disposal that are not used for normal operations.

12.2) Minimizing Accidental Explosions

Intelsat has assessed the probability of accidental explosions during and after completion of mission operations. The spacecraft is designed in a manner to minimize the potential for such explosions. Propellant tanks and thrusters are isolated using redundant valves and electrical power systems are shielded in accordance with standard industry practices. At the completion of the mission, and upon disposal of the spacecraft, Intelsat will ensure the removal of all stored energy on the spacecraft by depleting all propellant tanks, venting all pressurized systems and by leaving the batteries in a permanent discharge state.

12.3) Safe Flight Profiles

Intelsat has assessed and limited the probability of the space station becoming a source of debris as a result of collisions with large debris or other operational space stations. Intelsat plans to operate Intelsat 31 in conjunction with Intelsat 30 at 95.05° W.L. Intelsat will ensure that sufficient spatial separation is achieved between these two satellites through the use of orbit eccentricity and inclination offsets.[6]

With the exception of Intelsat 30, Intelsat 31 will not be located at the same orbital location as another satellite or at an orbital location that has an overlapping station keeping volume with another satellite. Intelsat is not aware of any other FCC licensed system, or any other system applied for and under consideration by the FCC, having an overlapping station-keeping volume with Intelsat 31. Intelsat is also not aware of any system with an overlapping station-keeping volume with Intelsat 31 that is the subject of an ITU filing and that is either in orbit or progressing towards launch.

12.4) Post Mission Disposal

At the end of the mission, Intelsat will dispose of the spacecraft by moving it to a minimum altitude of 289 kilometers above the geostationary arc, which is the altitude established by the IADC formula. Intelsat has reserved 120 kilograms of fuel for this purpose. The reserved fuel figure was determined by the spacecraft manufacturer and provided for in the propellant budget. To calculate this figure, the "rocket equation" was used, taking into account the expected mass of the satellite at the end of life and the required delta-velocity to achieve the desired orbit. The fuel gauging uncertainty has been taken into account in these calculations.

In calculating the disposal orbit, Intelsat has used simplifying assumptions as permitted under the Commission's Orbital Debris Report and Order. For reference, the effective area to mass ratio (Cr*A/M) of the Intelsat 31

[6] As noted above, Galaxy 3C is expected to be relocated upon the arrival of Intelsat 31. *See supra* n. 1.

spacecraft is 0.045 m^2/kg, resulting in a minimum perigee disposal altitude under the IADC formula of at most 289 kilometers above the geostationary arc. Accordingly, the Intelsat 31 planned disposal orbit complies with the FCC's rules.

13)<u>TC&R Control Earth Stations</u>

Intelsat will conduct TC&R operations through one or more of the following earth stations: Mountainside, Maryland; Atlanta, Georgia; Castle Rock, Colorado; Riverside, California; or Fillmore, California. Additionally, Intelsat is capable of remotely controlling Intelsat 31 from its facilities in Washington D.C.

Certification Statement

I hereby certify that I am a technically qualified person and am familiar with Part 25 of the Commission's rules. The contents of this engineering statement were prepared by me or under my direct supervision and to the best of my knowledge are complete and accurate.

/s/ Roya Shambayati	March 28, 2014
Roya Shambayati Intelsat Director Spectrum Strategy	Date

EXHIBIT 1: SUMMARY OF SPACECRAFT CHARACTERISTICS

GENERAL	
Spacecraft Name	Intelsat 31
Orbital Location	95. 05° W.L.
Spacecraft Manufacturer	Space Systems Loral
Spacecraft Model	SS/L 1300E
Spacecraft Type	3-axis stabilized
Spacecraft Dimensions	
Length	32.4 meters
Width	8.5 meters
Depth	8.3 meters
Spacecraft Expected Lifetime	≥15.0 years
Eclipse Capability	100%
Station-keeping	
North-South	±0.05°
East-West	±0.05°
Antenna Pointing Accuracy	
North-South, East-West, Rotational	0.1°, 0.1º, 0.3º
Spacecraft Reliability	70.0%
Payload Reliability	81.4%
Bus Reliability	86.0%
Propulsion Type	Bi-propellant and Electric (Stationary Plasma)
Deployed Area of Solar Array	89.2 sq. meters
Ranging Accuracy	≤ 30 meters

EXHIBIT 2: SPACECRAFT MASS BUDGET

Mass of Spacecraft without Fuel (kg)	3386
Mass of Fuel and Disposables (kg)	2914
Launch Mass (kg)	6300
Mass of Fuel at Beginning of Life (kg)	445
Mass of Xenon at Beginning of Life (kg)	260

EXHIBIT 3: SPACECRAFT POWER BUDGET

	BEGINNING OF LIFE		END OF LIFE	
	AUTUMN EQUINOX	SUMMER SOLSTICE	AUTUMN EQUINOX	SUMMER SOLSTICE
PAYLOAD (WATTS)	14658	14658	14658	14658
BUS (WATTS)	3456	1921	3456	1921
TOTAL LOAD (WATTS)	18114	16579	18114	16579
SOLAR ARRAY POWER (WATTS)	19552	17612	19462	17530
DEPTH OF BATTERY DISCHARGE (%)	65.8	N/A	69.7	N/A

EXHIBIT 4A: FREQUENCY PLAN

C-Band Frequency Plan

EXHIBIT 4A: FREQUENCY PLAN (continued)

Ku-Band Frequency Plan

EXHIBIT 4B: FREQUENCY ASSIGNMENTS

Uplink Transponder Designation	Uplink Beam Name	Uplink Polarization	Uplink Center Frequency (MHz)	Downlink Transponder Designation	Downlink Beam Name	Downlink Polarization	Downlink Center Frequency (MHz)	Channel Bandwidth (MHz)	Maximum Channel Gain (dB)
2C	Global	V	6459.8	2C	Global	H	3434.8	69.6	132.8
4C	Global	V	6536.4	4C	Global	H	3511.4	69.6	132.8
6C	Global	V	6613.0	6C	Global	H	3588.0	69.6	132.8
8C	Global	V	6689.6	8C	Global	H	3664.6	69.6	132.8
2K	CBC	H	13770.38	2K	Pan Regional	LHCP	11480.88	24	118.9
4K	CBC	H	13799.54	4K	Pan Regional	LHCP	11510.04	24	118.9
6K	CBC	H	13828.7	6K	Pan Regional	LHCP	11539.2	24	118.9
8K	CBC	H	13857.86	8K	Pan Regional	LHCP	11568.36	24	118.9
10K	CBC	H	13887.02	10K	Pan Regional	LHCP	11597.52	24	118.9
12K	CBC	H	13916.18	12K	Pan Regional	LHCP	11626.68	24	118.9
14K	CBC	H	13945.34	14K	Pan Regional	LHCP	11655.84	24	118.9
16K	CBC	H	13974.5	16K	Pan Regional	LHCP	11685	24	118.9
1K	CBC	V	13770.38	*1K	Pan Regional	RHCP	11480.88	24	121.4
3K	CBC	V	13799.54	*3K	Pan Regional	RHCP	11510.04	24	121.4
5K	CBC	V	13828.7	*5K	Pan Regional	RHCP	11539.2	24	121.4
7K	CBC	V	13857.86	*7K	Pan Regional	RHCP	11568.36	24	121.4
9K	CBC	V	13887.02	*9K	Pan Regional	RHCP	11597.52	24	121.4
11K	CBC	V	13916.18	*11K	Pan Regional	RHCP	11626.68	24	121.4
13K	CBC	V	13945.34	*13K	Pan Regional	RHCP	11655.84	24	121.4
15K	CBC	V	13974.5	*15K	Pan Regional	RHCP	11685	24	121.4
2K	VBC	H	13770.38	2K	Pan Regional	LHCP	11480.88	24	121.9
4K	VBC	H	13799.54	4K	Pan Regional	LHCP	11510.04	24	121.9
6K	VBC	H	13828.7	6K	Pan Regional	LHCP	11539.2	24	121.9
8K	VBC	H	13857.86	8K	Pan Regional	LHCP	11568.36	24	121.9
10K	VBC	H	13887.02	10K	Pan Regional	LHCP	11597.52	24	121.9
12K	VBC	H	13916.18	12K	Pan Regional	LHCP	11626.68	24	121.9
14K	VBC	H	13945.34	14K	Pan Regional	LHCP	11655.84	24	121.9
16K	VBC	H	13974.5	16K	Pan Regional	LHCP	11685	24	121.9
1K	VBC	V	13770.38	*1K	Pan Regional	RHCP	11480.88	24	124.4
3K	VBC	V	13799.54	*3K	Pan Regional	RHCP	11510.04	24	124.4
5K	VBC	V	13828.7	*5K	Pan Regional	RHCP	11539.2	24	124.4
7K	VBC	V	13857.86	*7K	Pan Regional	RHCP	11568.36	24	124.4
9K	VBC	V	13887.02	*9K	Pan Regional	RHCP	11597.52	24	124.4
11K	VBC	V	13916.18	*11K	Pan Regional	RHCP	11626.68	24	124.4
13K	VBC	V	13945.34	*13K	Pan Regional	RHCP	11655.84	24	124.4
15K	VBC	V	13974.5	*15K	Pan Regional	RHCP	11685	24	124.4
2K	CoBC	H	13770.38	2K	Pan Regional	LHCP	11480.88	24	119.9
4K	CoBC	H	13799.54	4K	Pan Regional	LHCP	11510.04	24	119.9
6K	CoBC	H	13828.7	6K	Pan Regional	LHCP	11539.2	24	119.9
8K	CoBC	H	13857.86	8K	Pan Regional	LHCP	11568.36	24	119.9
10K	CoBC	H	13887.02	10K	Pan Regional	LHCP	11597.52	24	119.9
12K	CoBC	H	13916.18	12K	Pan Regional	LHCP	11626.68	24	119.9
14K	CoBC	H	13945.34	14K	Pan Regional	LHCP	11655.84	24	119.9
16K	CoBC	H	13974.5	16K	Pan Regional	LHCP	11685	24	119.9
1K	CoBC	V	13770.38	*1K	Pan Regional	RHCP	11480.88	24	122.4
3K	CoBC	V	13799.54	*3K	Pan Regional	RHCP	11510.04	24	122.4
5K	CoBC	V	13828.7	*5K	Pan Regional	RHCP	11539.2	24	122.4
7K	CoBC	V	13857.86	*7K	Pan Regional	RHCP	11568.36	24	122.4
9K	CoBC	V	13887.02	*9K	Pan Regional	RHCP	11597.52	24	122.4
11K	CoBC	V	13916.18	*11K	Pan Regional	RHCP	11626.68	24	122.4
13K	CoBC	V	13945.34	*13K	Pan Regional	RHCP	11655.84	24	122.4
15K	CoBC	V	13974.5	*15K	Pan Regional	RHCP	11685	24	122.4

EXHIBIT 4B: FREQUENCY ASSIGNMENTS (continued)

Uplink Transponder Designation	Uplink Beam Name	Uplink Polarization	Uplink Center Frequency (MHz)	Downlink Transponder Designation	Downlink Beam Name	Downlink Polarization	Downlink Center Frequency (MHz)	Channel Bandwidth (MHz)	Maximum Channel Gain (dB)
18K	ABC	H	14275	18K	Pan Regional	LHCP	11975	24	120.4
20K	ABC	H	14305	20K	Pan Regional	LHCP	12005	24	120.4
22K	ABC	H	14335	22K	Pan Regional	LHCP	12035	24	120.4
24K	ABC	H	14365	24K	Pan Regional	LHCP	12065	24	120.4
26K	ABC	H	14395	26K	Pan Regional	LHCP	12095	24	120.4
28K	ABC	H	14425	28K	Pan Regional	LHCP	12125	24	120.4
30K	ABC	H	14455	30K	Pan Regional	LHCP	12155	24	120.4
32K	ABC	H	14485	32K	Pan Regional	LHCP	12185	24	120.4
17K	ABC	V	14260	17K	Pan Regional	RHCP	11960	24	120.4
19K	ABC	V	14290	19K	Pan Regional	RHCP	11990	24	120.4
21K	ABC	V	14320	21K	Pan Regional	RHCP	12020	24	120.4
23K	ABC	V	14350	23K	Pan Regional	RHCP	12050	24	120.4
25K	ABC	V	14380	25K	Pan Regional	RHCP	12080	24	120.4
27K	ABC	V	14410	27K	Pan Regional	RHCP	12110	24	120.4
29K	ABC	V	14440	29K	Pan Regional	RHCP	12140	24	120.4
31K	ABC	V	14470	31K	Pan Regional	RHCP	12170	24	120.4
18K	BBC	H	14275	18K	Pan Regional	LHCP	11975	24	119.0
20K	BBC	H	14305	20K	Pan Regional	LHCP	12005	24	119.0
22K	BBC	H	14335	22K	Pan Regional	LHCP	12035	24	119.0
24K	BBC	H	14365	24K	Pan Regional	LHCP	12065	24	119.0
26K	BBC	H	14395	26K	Pan Regional	LHCP	12095	24	119.0
28K	BBC	H	14425	28K	Pan Regional	LHCP	12125	24	119.0
30K	BBC	H	14455	30K	Pan Regional	LHCP	12155	24	119.0
32K	BBC	H	14485	32K	Pan Regional	LHCP	12185	24	119.0
17K	BBC	V	14260	17K	Pan Regional	RHCP	11960	24	119.0
19K	BBC	V	14290	19K	Pan Regional	RHCP	11990	24	119.0
21K	BBC	V	14320	21K	Pan Regional	RHCP	12020	24	119.0
23K	BBC	V	14350	23K	Pan Regional	RHCP	12050	24	119.0
25K	BBC	V	14380	25K	Pan Regional	RHCP	12080	24	119.0
27K	BBC	V	14410	27K	Pan Regional	RHCP	12110	24	119.0
29K	BBC	V	14440	29K	Pan Regional	RHCP	12140	24	119.0
31K	BBC	V	14470	31K	Pan Regional	RHCP	12170	24	119.0
34K	ABC	H	13776	34K	Region 3	LHCP	10970	36	119.7
36K	ABC	H	13816	36K	Region 3	LHCP	11010	36	119.7
38K	ABC	H	13856	38K	Region 3	LHCP	11050	36	119.7
40K	ABC	H	13896	40K	Region 3	LHCP	11090	36	119.7
42K	ABC	H	13936	42K	Region 3	LHCP	11130	36	119.7
44K	ABC	H	13976	44K	Region 3	LHCP	11170	36	119.7
33K	ABC	V	13776	*33K	Region 3	RHCP	10970	36	122.4
35K	ABC	V	13816	35K	Region 3	RHCP	11010	36	119.7
37K	ABC	V	13856	*37K	Region 3	RHCP	11050	36	122.4
39K	ABC	V	13896	39K	Region 3	RHCP	11090	36	119.7
41K	ABC	V	13936	*41K	Region 3	RHCP	11130	36	122.4
43K	ABC	V	13976	43K	Region 3	RHCP	11170	36	119.7
34K	BBC	H	13776	34K	Region 3	LHCP	10970	36	118.3
36K	BBC	H	13816	36K	Region 3	LHCP	11010	36	118.3
38K	BBC	H	13856	38K	Region 3	LHCP	11050	36	118.3
40K	BBC	H	13896	40K	Region 3	LHCP	11090	36	118.3
42K	BBC	H	13936	42K	Region 3	LHCP	11130	36	118.3
44K	BBC	H	13976	44K	Region 3	LHCP	11170	36	118.3

EXHIBIT 4B: FREQUENCY ASSIGNMENTS (continued)

Uplink Transponder Designation	Uplink Beam Name	Uplink Polarization	Uplink Center Frequency (MHz)	Downlink Transponder Designation	Downlink Beam Name	Downlink Polarization	Downlink Center Frequency (MHz)	Channel Bandwidth (MHz)	Maximum Channel Gain (dB)
33K	BBC	V	13776	*33K	Region 3	RHCP	10970	36	121.0
35K	BBC	V	13816	35K	Region 3	RHCP	11010	36	118.3
37K	BBC	V	13856	*37K	Region 3	RHCP	11050	36	121.0
39K	BBC	V	13896	39K	Region 3	RHCP	11090	36	118.3
41K	BBC	V	13936	*41K	Region 3	RHCP	11130	36	121.0
43K	BBC	V	13976	43K	Region 3	RHCP	11170	36	118.3
46K	ABC	H	14030	46K	Region 3	LHCP	11730	36	119.8
48K	ABC	H	14070	48K	Region 3	LHCP	11770	36	119.8
50K	ABC	H	14110	50K	Region 3	LHCP	11810	36	119.8
52K	ABC	H	14150	52K	Region 3	LHCP	11850	36	119.8
54K	ABC	H	14190	54K	Region 3	LHCP	11890	36	119.8
56K	ABC	H	14230	56K	Region 3	LHCP	11930	36	119.8
45K	ABC	V	14026	*45K	Region 3	RHCP	11726	36	122.5
47K	ABC	V	14066	47K	Region 3	RHCP	11766	36	119.8
49K	ABC	V	14106	*49K	Region 3	RHCP	11806	36	122.5
51K	ABC	V	14146	51K	Region 3	RHCP	11846	36	119.8
53K	ABC	V	14186	*53K	Region 3	RHCP	11886	36	122.5
55K	ABC	V	14226	55K	Region 3	RHCP	11926	36	119.8
46K	BBC	H	14030	46K	Region 3	LHCP	11730	36	118.4
48K	BBC	H	14070	48K	Region 3	LHCP	11770	36	118.4
50K	BBC	H	14110	50K	Region 3	LHCP	11810	36	118.4
52K	BBC	H	14150	52K	Region 3	LHCP	11850	36	118.4
54K	BBC	H	14190	54K	Region 3	LHCP	11890	36	118.4
56K	BBC	H	14230	56K	Region 3	LHCP	11930	36	118.4
45K	BBC	V	14026	*45K	Region 3	RHCP	11726	36	121.1
47K	BBC	V	14066	47K	Region 3	RHCP	11766	36	118.4
49K	BBC	V	14106	*49K	Region 3	RHCP	11806	36	121.1
51K	BBC	V	14146	51K	Region 3	RHCP	11846	36	118.4
53K	BBC	V	14186	*53K	Region 3	RHCP	11886	36	121.1
55K	BBC	V	14226	55K	Region 3	RHCP	11926	36	118.4
34K	ABC	H	13776	34K	Region 4	LHCP	10970	36	119.7
36K	ABC	H	13816	36K	Region 4	LHCP	11010	36	119.7
38K	ABC	H	13856	38K	Region 4	LHCP	11050	36	119.7
40K	ABC	H	13896	40K	Region 4	LHCP	11090	36	119.7
42K	ABC	H	13936	42K	Region 4	LHCP	11130	36	119.7
44K	ABC	H	13976	44K	Region 4	LHCP	11170	36	119.7
33K	ABC	V	13776	*33K	Region 4	RHCP	10970	36	122.4
35K	ABC	V	13816	35K	Region 4	RHCP	11010	36	119.7
37K	ABC	V	13856	*37K	Region 4	RHCP	11050	36	122.4
39K	ABC	V	13896	39K	Region 4	RHCP	11090	36	119.7
41K	ABC	V	13936	*41K	Region 4	RHCP	11130	36	122.4
43K	ABC	V	13976	43K	Region 4	RHCP	11170	36	119.7
34K	BBC	H	13776	34K	Region 4	LHCP	10970	36	118.4
36K	BBC	H	13816	36K	Region 4	LHCP	11010	36	118.4
38K	BBC	H	13856	38K	Region 4	LHCP	11050	36	118.4
40K	BBC	H	13896	40K	Region 4	LHCP	11090	36	118.4
42K	BBC	H	13936	42K	Region 4	LHCP	11130	36	118.4
44K	BBC	H	13976	44K	Region 4	LHCP	11170	36	118.4

EXHIBIT 4B: FREQUENCY ASSIGNMENTS (continued)

Uplink Transponder Designation	Uplink Beam Name	Uplink Polarization	Uplink Center Frequency (MHz)	Downlink Transponder Designation	Downlink Beam Name	Downlink Polarization	Downlink Center Frequency (MHz)	Channel Bandwidth (MHz)	Maximum Channel Gain (dB)
33K	BBC	V	13776	*33K	Region 4	RHCP	10970	36	121.1
35K	BBC	V	13816	35K	Region 4	RHCP	11010	36	118.4
37K	BBC	V	13856	*37K	Region 4	RHCP	11050	36	121.1
39K	BBC	V	13896	39K	Region 4	RHCP	11090	36	118.4
41K	BBC	V	13936	*41K	Region 4	RHCP	11130	36	121.1
43K	BBC	V	13976	43K	Region 4	RHCP	11170	36	118.4
46K	ABC	H	14030	46K	Region 4	LHCP	11730	36	119.8
48K	ABC	H	14070	48K	Region 4	LHCP	11770	36	119.8
50K	ABC	H	14110	50K	Region 4	LHCP	11810	36	119.8
52K	ABC	H	14150	52K	Region 4	LHCP	11850	36	119.8
54K	ABC	H	14190	54K	Region 4	LHCP	11890	36	119.8
56K	ABC	H	14230	56K	Region 4	LHCP	11930	36	119.8
45K	ABC	V	14026	*45K	Region 4	RHCP	11726	36	122.5
47K	ABC	V	14066	47K	Region 4	RHCP	11766	36	119.8
49K	ABC	V	14106	*49K	Region 4	RHCP	11806	36	122.5
51K	ABC	V	14146	51K	Region 4	RHCP	11846	36	119.8
53K	ABC	V	14186	*53K	Region 4	RHCP	11886	36	122.5
55K	ABC	V	14226	55K	Region 4	RHCP	11926	36	119.8
46K	BBC	H	14030	46K	Region 4	LHCP	11730	36	118.4
48K	BBC	H	14070	48K	Region 4	LHCP	11770	36	118.4
50K	BBC	H	14110	50K	Region 4	LHCP	11810	36	118.4
52K	BBC	H	14150	52K	Region 4	LHCP	11850	36	118.4
54K	BBC	H	14190	54K	Region 4	LHCP	11890	36	118.4
56K	BBC	H	14230	56K	Region 4	LHCP	11930	36	118.4
45K	BBC	V	14026	*45K	Region 4	RHCP	11726	36	121.1
47K	BBC	V	14066	47K	Region 4	RHCP	11766	36	118.4
49K	BBC	V	14106	*49K	Region 4	RHCP	11806	36	121.1
51K	BBC	V	14146	51K	Region 4	RHCP	11846	36	118.4
53K	BBC	V	14186	*53K	Region 4	RHCP	11886	36	121.1
55K	BBC	V	14226	55K	Region 4	RHCP	11926	36	118.4
70K	CoBC	H	14270	70K	Region 1	LHCP	10970	36	120.7
72K	CoBC	H	14310	*72K	Region 1	LHCP	11010	36	117.9
74K	CoBC	H	14350	74K	Region 1	LHCP	11050	36	120.7
76K	CoBC	H	14390	*76K	Region 1	LHCP	11090	36	117.9
78K	CoBC	H	14430	78K	Region 1	LHCP	11130	36	120.7
80K	CoBC	H	14470	*80K	Region 1	LHCP	11170	36	117.9
69K	CoBC	V	14270	69K	Region 1	RHCP	10970	36	117.9
71K	CoBC	V	14310	71K	Region 1	RHCP	11010	36	117.9
73K	CoBC	V	14350	73K	Region 1	RHCP	11050	36	117.9
75K	CoBC	V	14390	75K	Region 1	RHCP	11090	36	117.9
77K	CoBC	V	14430	77K	Region 1	RHCP	11130	36	117.9
79K	CoBC	V	14470	79K	Region 1	RHCP	11170	36	117.9
70K	VBC	H	14270	70K	Region 1	LHCP	10970	36	119.9
72K	VBC	H	14310	*72K	Region 1	LHCP	11010	36	122.7
74K	VBC	H	14350	74K	Region 1	LHCP	11050	36	119.9
76K	VBC	H	14390	*76K	Region 1	LHCP	11090	36	122.7
78K	VBC	H	14430	78K	Region 1	LHCP	11130	36	119.9
80K	VBC	H	14470	*80K	Region 1	LHCP	11170	36	122.7

EXHIBIT 4B: FREQUENCY ASSIGNMENTS (continued)

Uplink Transponder Designation	Uplink Beam Name	Uplink Polarization	Uplink Center Frequency (MHz)	Downlink Transponder Designation	Downlink Beam Name	Downlink Polarization	Downlink Center Frequency (MHz)	Channel Bandwidth (MHz)	Maximum Channel Gain (dB)
69K	VBC	V	14270	69K	Region 1	RHCP	10970	36	119.9
71K	VBC	V	14310	71K	Region 1	RHCP	11010	36	119.9
73K	VBC	V	14350	73K	Region 1	RHCP	11050	36	119.9
75K	VBC	V	14390	75K	Region 1	RHCP	11090	36	119.9
77K	VBC	V	14430	77K	Region 1	RHCP	11130	36	119.9
79K	VBC	V	14470	79K	Region 1	RHCP	11170	36	119.9
58K	CoBC	H	14030	58K	Region 1	LHCP	11730	36	117.7
60K	CoBC	H	14070	60K	Region 1	LHCP	11770	36	117.7
62K	CoBC	H	14110	62K	Region 1	LHCP	11810	36	117.7
64K	CoBC	H	14150	64K	Region 1	LHCP	11850	36	117.7
66K	CoBC	H	14190	66K	Region 1	LHCP	11890	36	117.7
68K	CoBC	H	14230	68K	Region 1	LHCP	11930	36	117.7
57K	CoBC	V	14026	57K	Region 1	RHCP	11726	36	117.7
59K	CoBC	V	14066	*59K	Region 1	RHCP	11766	36	120.6
61K	CoBC	V	14106	61K	Region 1	RHCP	11806	36	117.7
63K	CoBC	V	14146	*63K	Region 1	RHCP	11846	36	120.6
65K	CoBC	V	14186	65K	Region 1	RHCP	11886	36	117.7
67K	CoBC	V	14226	*67K	Region 1	RHCP	11926	36	120.6
58K	VBC	H	14030	58K	Region 1	LHCP	11730	36	119.7
60K	VBC	H	14070	60K	Region 1	LHCP	11770	36	119.7
62K	VBC	H	14110	62K	Region 1	LHCP	11810	36	119.7
64K	VBC	H	14150	64K	Region 1	LHCP	11850	36	119.7
66K	VBC	H	14190	66K	Region 1	LHCP	11890	36	119.7
68K	VBC	H	14230	68K	Region 1	LHCP	11930	36	119.7
57K	VBC	V	14026	57K	Region 1	RHCP	11726	36	119.7
59K	VBC	V	14066	*59K	Region 1	RHCP	11766	36	122.5
61K	VBC	V	14106	61K	Region 1	RHCP	11806	36	119.7
63K	VBC	V	14146	*63K	Region 1	RHCP	11846	36	122.5
65K	VBC	V	14186	65K	Region 1	RHCP	11886	36	119.7
67K	VBC	V	14226	*67K	Region 1	RHCP	11926	36	122.5
58K	CoBC	H	14030	58K	Region 2	LHCP	11730	36	117.8
60K	CoBC	H	14070	60K	Region 2	LHCP	11770	36	117.8
62K	CoBC	H	14110	62K	Region 2	LHCP	11810	36	117.8
64K	CoBC	H	14150	64K	Region 2	LHCP	11850	36	117.8
66K	CoBC	H	14190	66K	Region 2	LHCP	11890	36	117.8
68K	CoBC	H	14230	68K	Region 2	LHCP	11930	36	117.8
57K	CoBC	V	14026	57K	Region 2	RHCP	11726	36	117.8
59K	CoBC	V	14066	*59K	Region 2	RHCP	11766	36	120.5
61K	CoBC	V	14106	61K	Region 2	RHCP	11806	36	117.8
63K	CoBC	V	14146	*63K	Region 2	RHCP	11846	36	120.5
65K	CoBC	V	14186	65K	Region 2	RHCP	11886	36	117.8
67K	CoBC	V	14226	*67K	Region 2	RHCP	11926	36	120.5
58K	VBC	H	14030	58K	Region 2	LHCP	11730	36	119.8
60K	VBC	H	14070	60K	Region 2	LHCP	11770	36	119.8
62K	VBC	H	14110	62K	Region 2	LHCP	11810	36	119.8
64K	VBC	H	14150	64K	Region 2	LHCP	11850	36	119.8
66K	VBC	H	14190	66K	Region 2	LHCP	11890	36	119.8
68K	VBC	H	14230	68K	Region 2	LHCP	11930	36	119.8

EXHIBIT 4B: FREQUENCY ASSIGNMENTS (continued)

Uplink Transponder Designation	Uplink Beam Name	Uplink Polarization	Uplink Center Frequency (MHz)	Downlink Transponder Designation	Downlink Beam Name	Downlink Polarization	Downlink Center Frequency (MHz)	Channel Bandwidth (MHz)	Maximum Channel Gain (dB)
57K	VBC	V	14026	57K	Region 2	RHCP	11726	36	119.8
59K	VBC	V	14066	*59K	Region 2	RHCP	11766	36	122.5
61K	VBC	V	14106	61K	Region 2	RHCP	11806	36	119.8
63K	VBC	V	14146	*63K	Region 2	RHCP	11846	36	122.5
65K	VBC	V	14186	65K	Region 2	RHCP	11886	36	119.8
67K	VBC	V	14226	*67K	Region 2	RHCP	11926	36	122.5
70K	CoBC	H	14270	70K	Region 2	LHCP	10970	36	118.0
72K	CoBC	H	14310	*72K	Region 2	LHCP	11010	36	120.7
74K	CoBC	H	14350	74K	Region 2	LHCP	11050	36	118.0
76K	CoBC	H	14390	*76K	Region 2	LHCP	11090	36	120.7
78K	CoBC	H	14430	78K	Region 2	LHCP	11130	36	118.0
80K	CoBC	H	14470	*80K	Region 2	LHCP	11170	36	120.7
69K	CoBC	V	14270	69K	Region 2	RHCP	10970	36	118.0
71K	CoBC	V	14310	71K	Region 2	RHCP	11010	36	118.0
73K	CoBC	V	14350	73K	Region 2	RHCP	11050	36	118.0
75K	CoBC	V	14390	75K	Region 2	RHCP	11090	36	118.0
77K	CoBC	V	14430	77K	Region 2	RHCP	11130	36	118.0
79K	CoBC	V	14470	79K	Region 2	RHCP	11170	36	118.0
70K	VBC	H	14270	70K	Region 2	LHCP	10970	36	120.0
72K	VBC	H	14310	*72K	Region 2	LHCP	11010	36	122.7
74K	VBC	H	14350	74K	Region 2	LHCP	11050	36	120.0
76K	VBC	H	14390	*76K	Region 2	LHCP	11090	36	122.7
78K	VBC	H	14430	78K	Region 2	LHCP	11130	36	120.0
80K	VBC	H	14470	*80K	Region 2	LHCP	11170	36	122.7
69K	VBC	V	14270	69K	Region 2	RHCP	10970	36	120.0
71K	VBC	V	14310	71K	Region 2	RHCP	11010	36	120.0
73K	VBC	V	14350	73K	Region 2	RHCP	11050	36	120.0
75K	VBC	V	14390	75K	Region 2	RHCP	11090	36	120.0
77K	VBC	V	14430	77K	Region 2	RHCP	11130	36	120.0
79K	VBC	V	14470	79K	Region 2	RHCP	11170	36	120.0
TCN	Global	V	14495	TCN	Pan Regional	RHCP	11460	8.0	138.3
TCN	Global	V	14495	TCN	CBC	RHCP	11460	8.0	128.5
CMD1	Global	H	13998.5					1.0	
CMD2	Global	H	14006.0					1.0	
CMD2	Global	LHCP	13998.5					1.0	
CMD 3	Global	LHCP	14006					1.0	
				TLM1	Global	V	11194.25	0.5	
				TLM2	Global	V	11195.5	0.5	
				TLM3	Global	V	11196.25	0.5	
				TLM4	Global	V	11196.75	0.5	
				TLM5	Global	RHCP	11194.25	0.5	
				TLM6	Global	RHCP	11195.5	0.5	
				TLM7	Global	RHCP	11196.25	0.5	
				TLM8	Global	RHCP	11196.75	0.5	
				UPK1	Global	LHCP	11705.5	0.025	
				UPK2	Global	RHCP	11193.0	0.025	

*Channel may be operated in high power mode.

EXHIBIT 5A-1: C-band Global Receive Beam
(Schedule S Beam ID:CGVU)

Beam Polarization: Vertical
Peak Beam Gain: 21.0 dBi
Peak Beam G/T: -7.8 dB/K
Saturated Flux Density @ Peak Beam G/T: -100 to -79 dBW/m^2

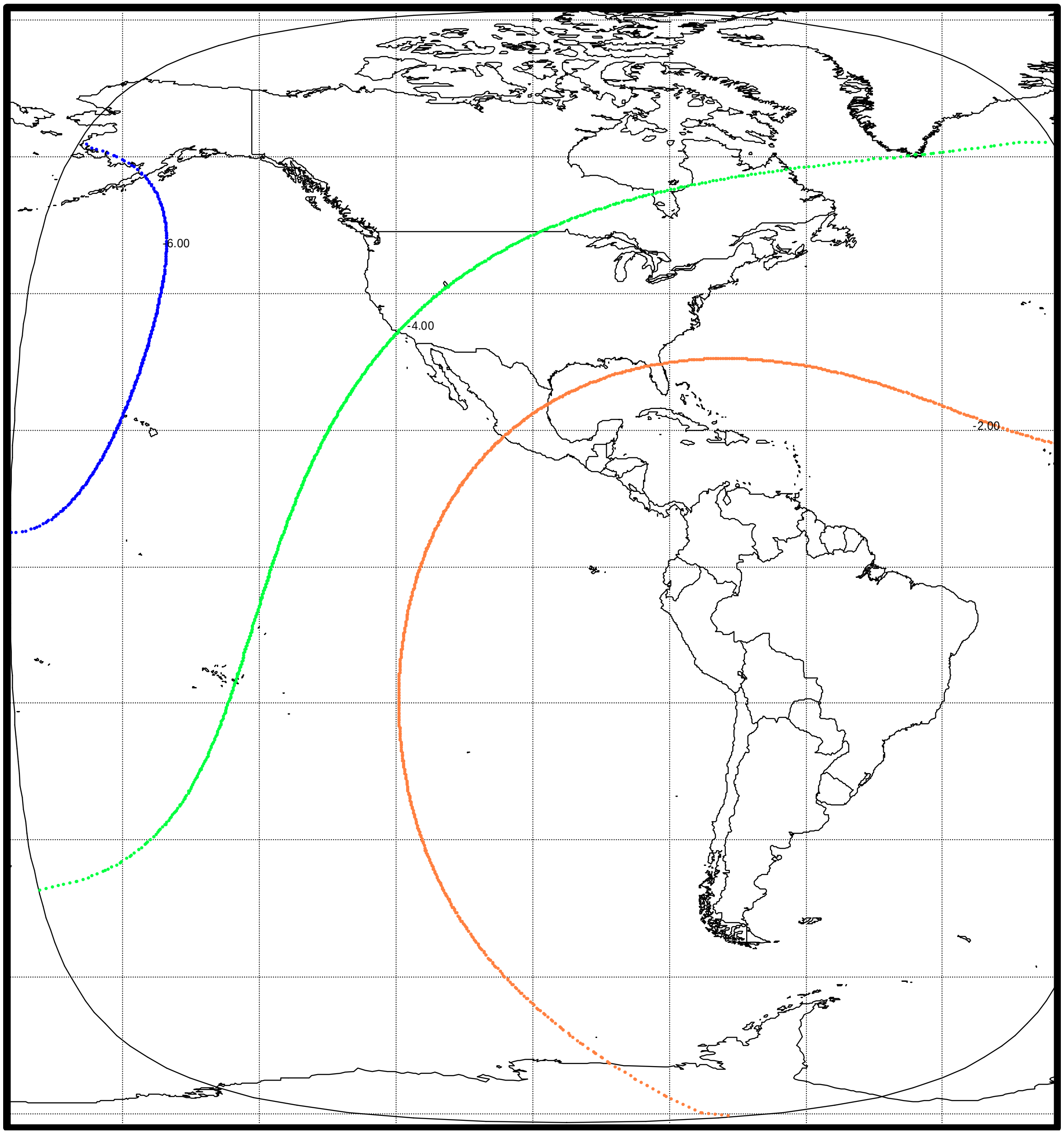


EXHIBIT 5A-2: ABC Receive Beam
(Schedule S Beam ID: ABCH)

Beam Polarization: Horizontal
Peak Beam Gain: 44.1 dBi
Peak Beam G/T: 14.7 dB/K
Saturated Flux Density @ Peak Beam G/T: -101.4 to -81.4 dBW/m^2

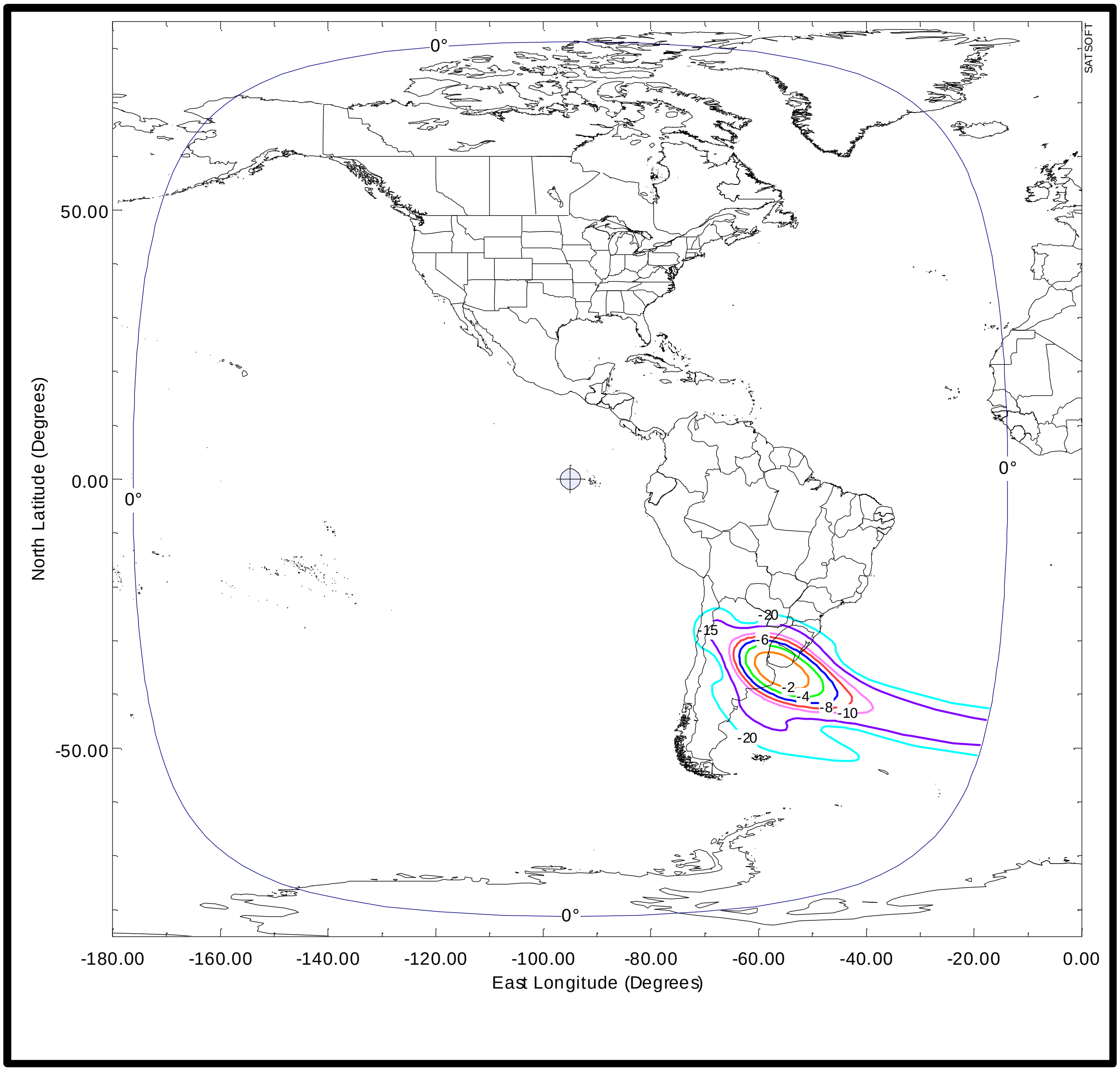


EXHIBIT 5A-3: ABC Receive Beam
(Schedule S Beam ID: ABCV)

Beam Polarization: Vertical
Peak Beam Gain: 44.1 dBi
Peak Beam G/T: 14.7 dB/K
Saturated Flux Density @ Peak Beam G/T: -101.4 to -81.4 dBW/m^2

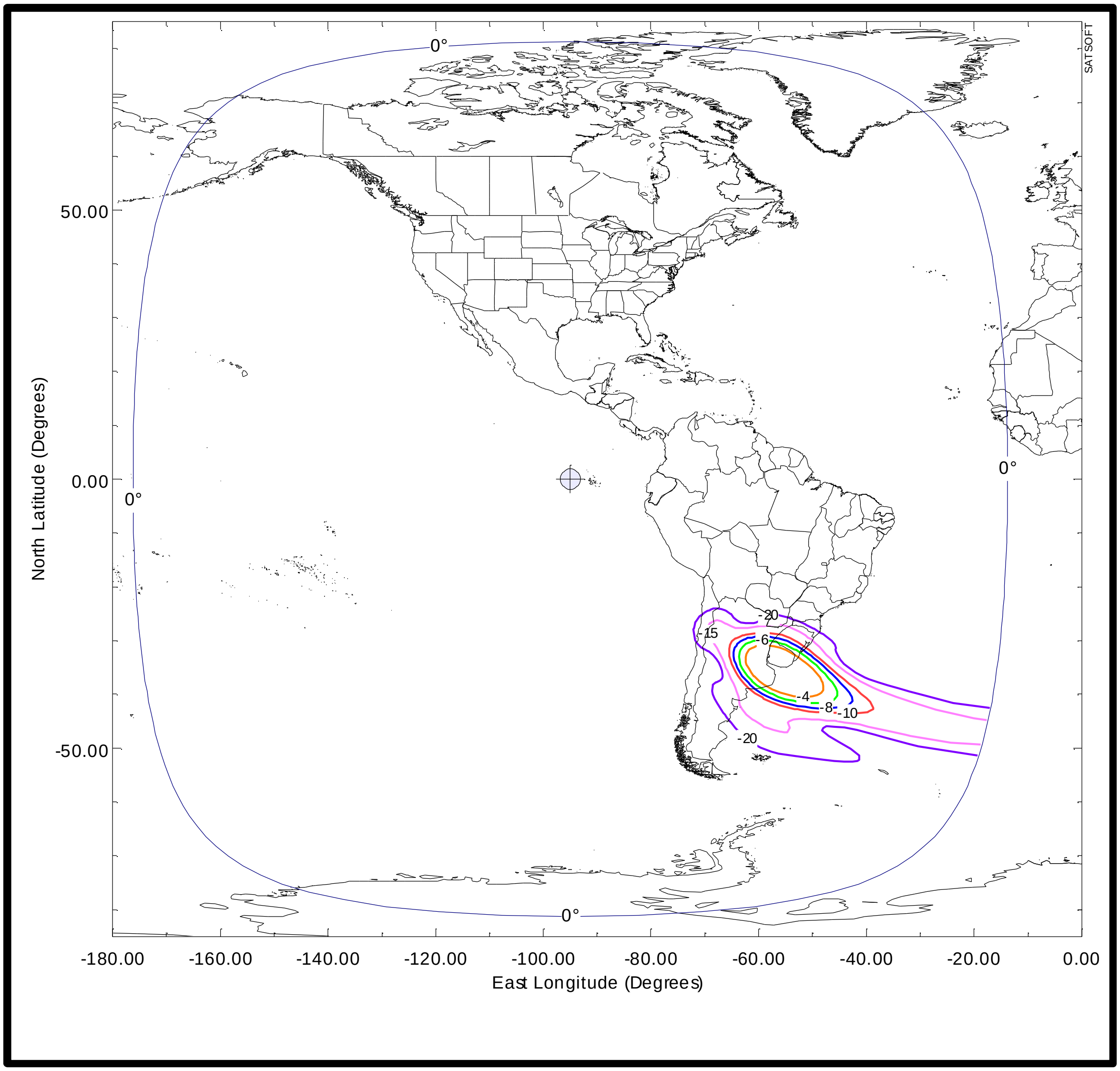


EXHIBIT 5A-4: BBC Receive Beam
(Schedule S Beam ID: BBCH)

Beam Polarization: Horizontal
Peak Beam Gain: 44.3 dBi
Peak Beam G/T: 15.2 dB/K
Saturated Flux Density @ Peak Beam G/T: -100.2 to -80.2 dBW/m^2

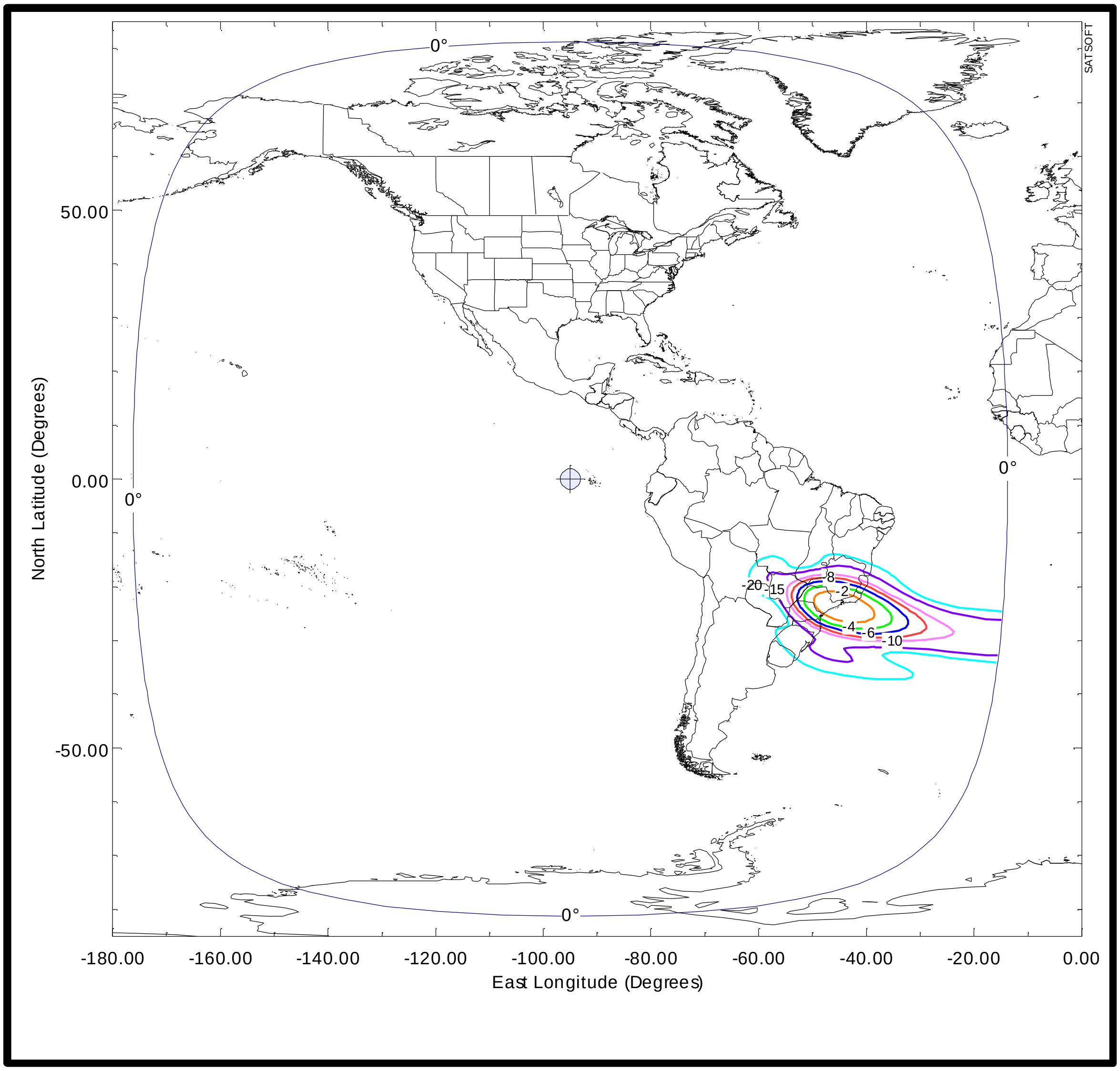
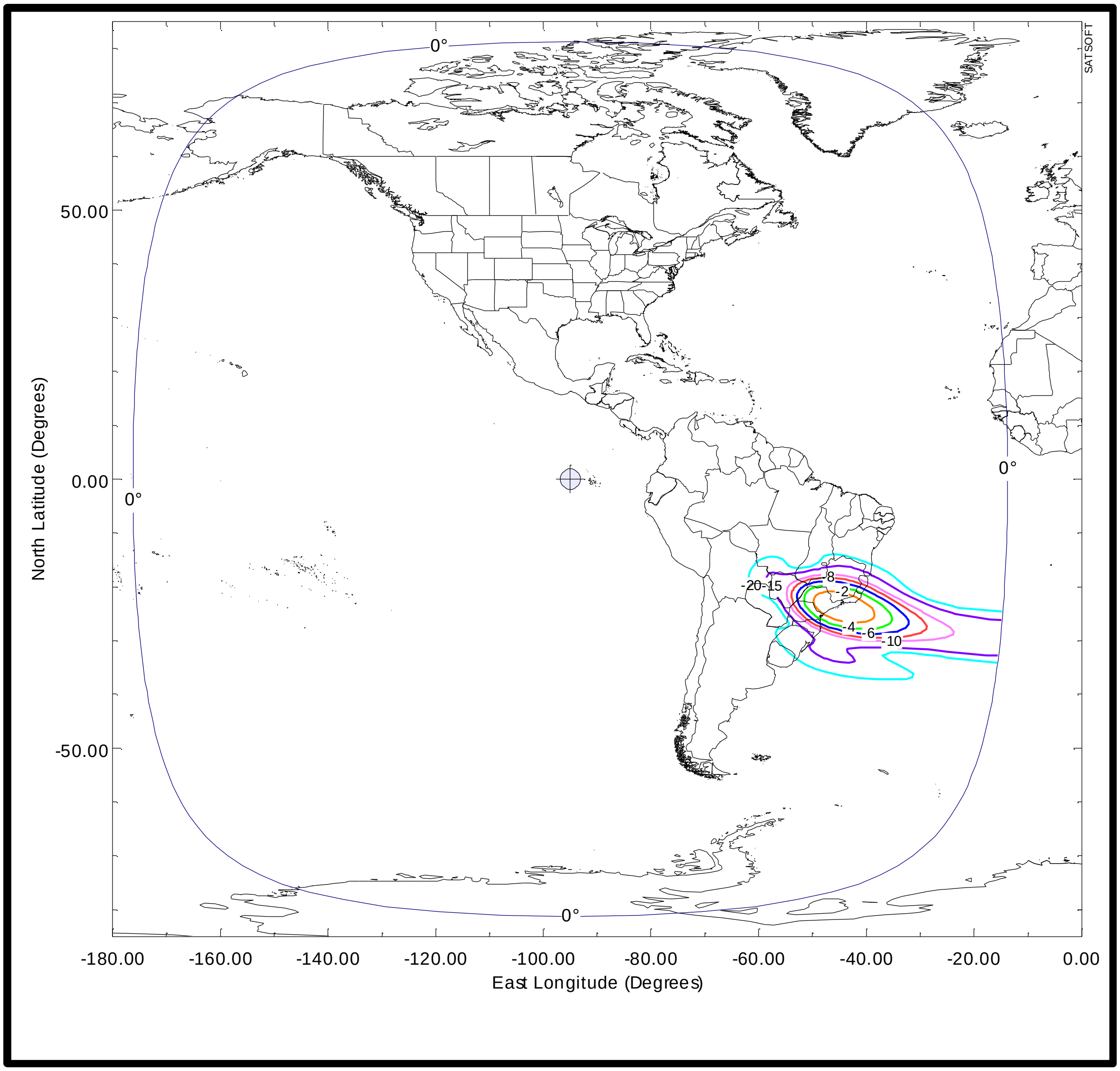


EXHIBIT 5A-5: BBC Receive Beam
(Schedule S Beam ID: BBCV)

Beam Polarization: Vertical
Peak Beam Gain: 44.3 dBi
Peak Beam G/T: 15.2 dB/K
Saturated Flux Density @ Peak Beam G/T: -100.2 to -80.2 dBW/m^2



<u>**EXHIBIT 5A-6: CBC Receive Beam**</u>
<u>**(Schedule S Beam ID: CBCH)**</u>

Beam Polarization: Horizontal
Peak Beam Gain: 43.2 dBi
Peak Beam G/T: 14.1 dB/K
Saturated Flux Density @ Peak Beam G/T: -99.3 to -79.3 dBW/m^2

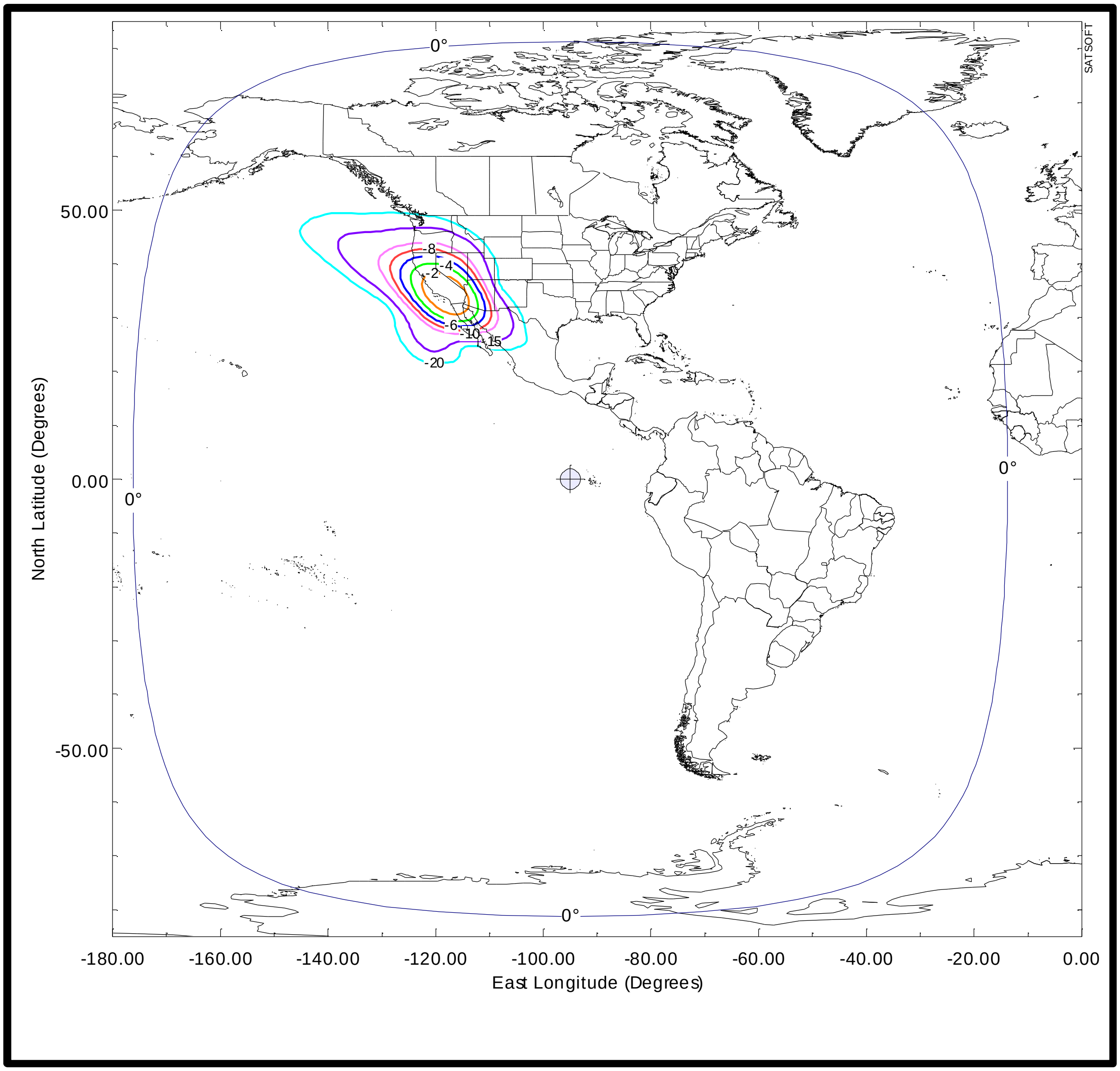


EXHIBIT 5A-7: CBC Receive Beam
(Schedule S Beam ID: CBCV)

Beam Polarization: Vertical
Peak Beam Gain: 43.2 dBi
Peak Beam G/T: 14.1 dB/K
Saturated Flux Density @ Peak Beam G/T: -99.3 to -79.3 dBW/m^2

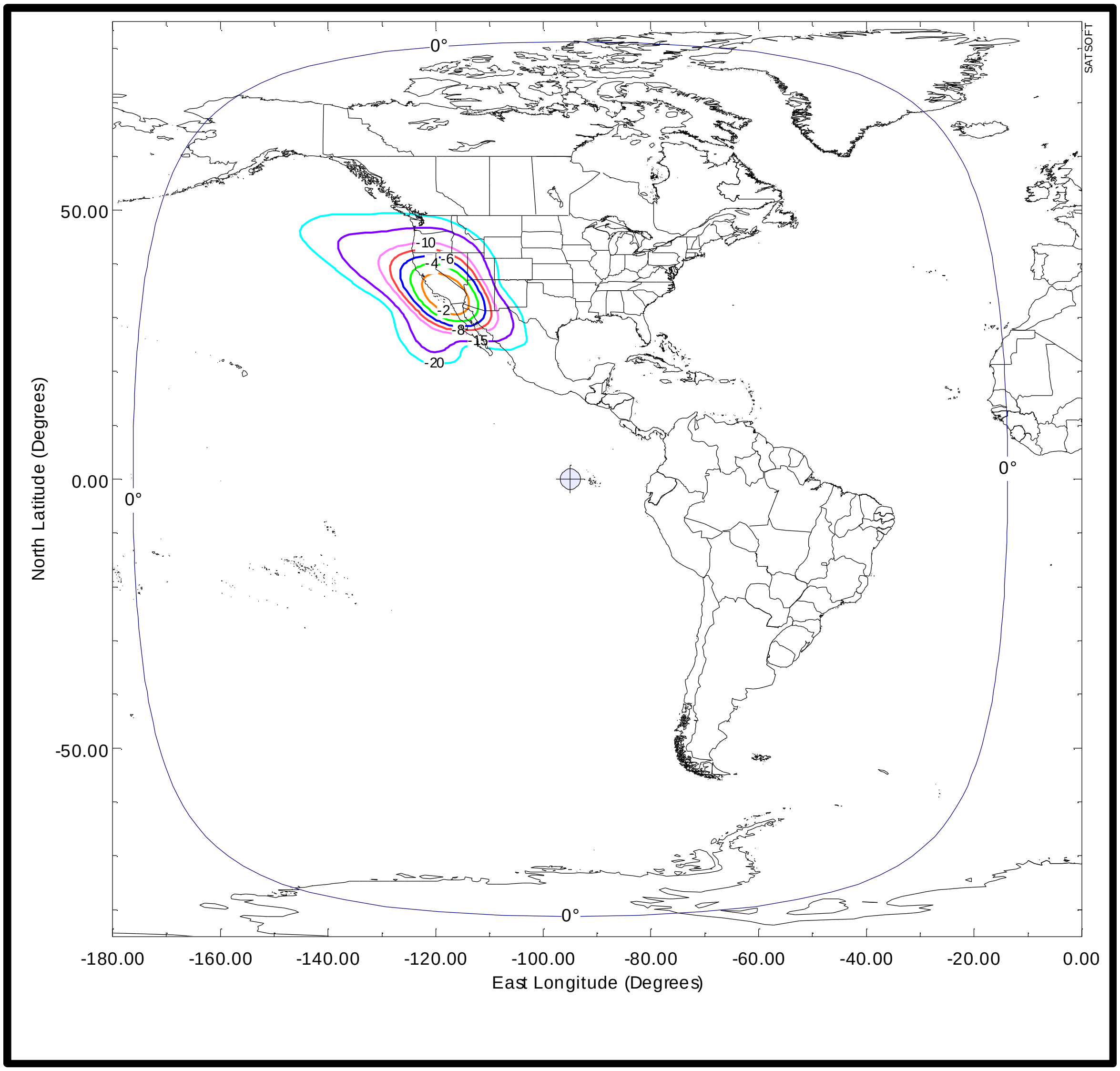


EXHIBIT 5A-8: CoBC Receive Beam
(Schedule S Beam ID: COBH)

Beam Polarization: Horizontal
Peak Beam Gain: 44.3 dBi
Peak Beam G/T: 15.3 dB/K
Saturated Flux Density @ Peak Beam G/T: -101.4 to -81.4 dBW/m^2

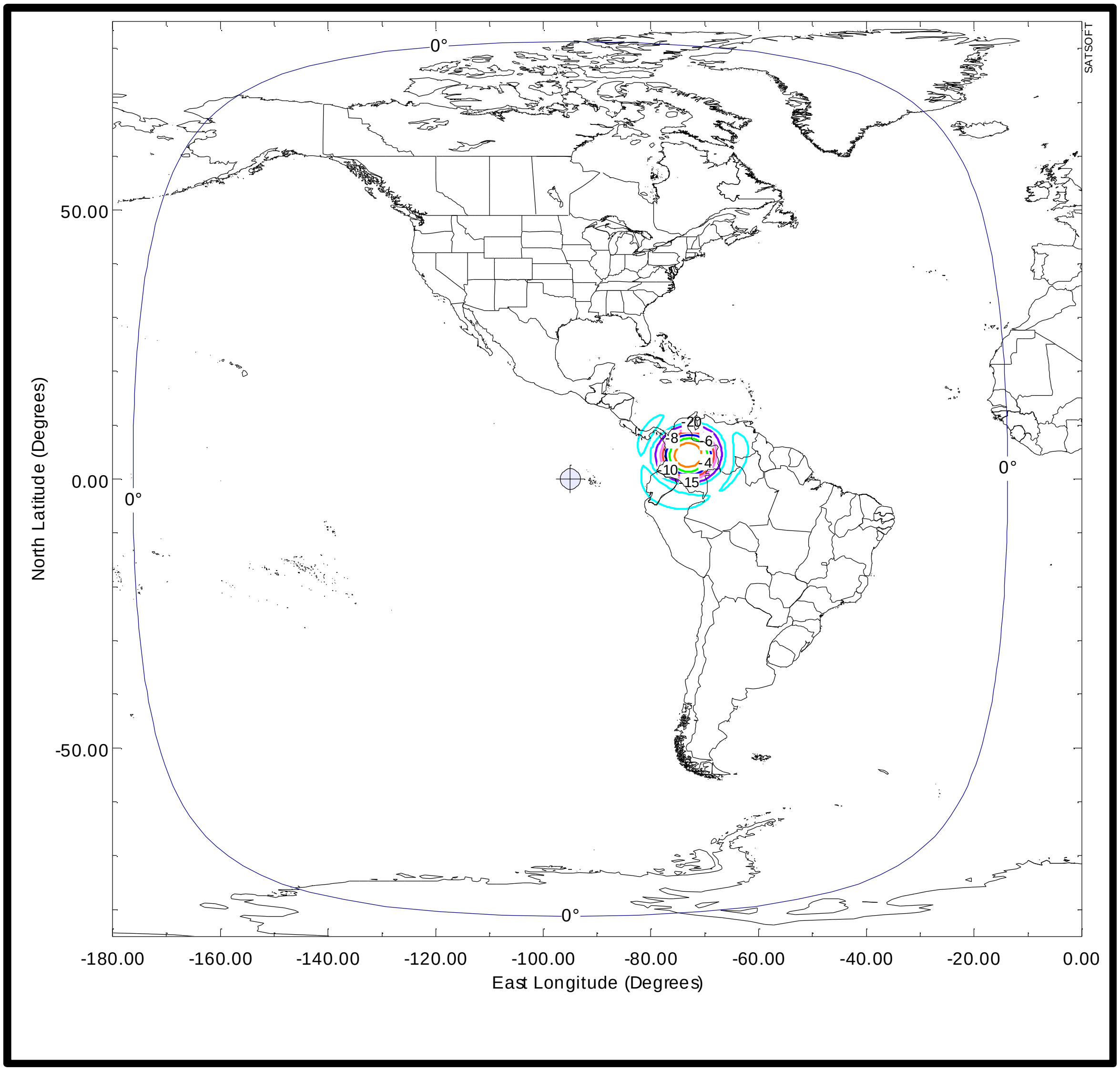
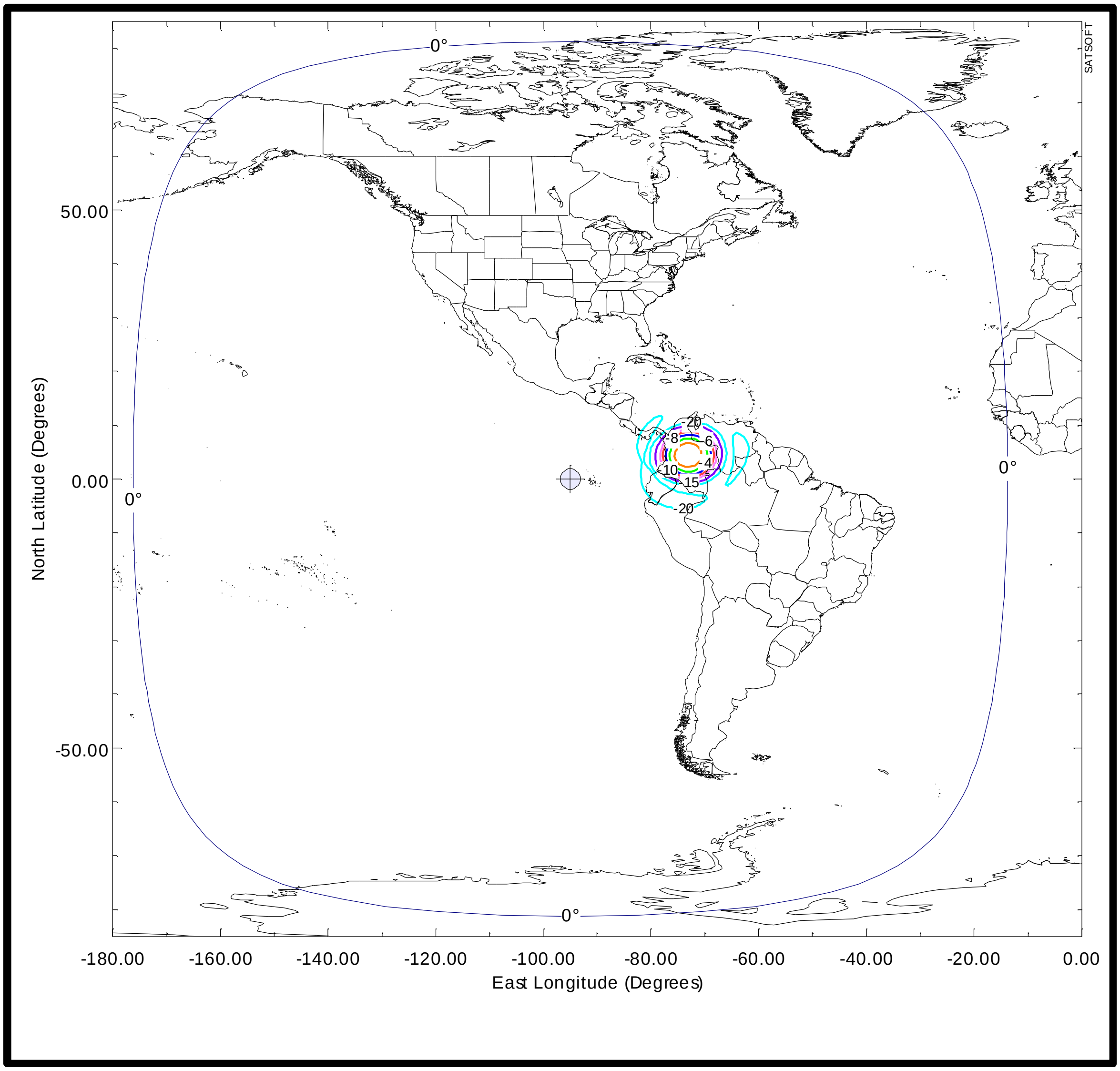


EXHIBIT 5A-9: CoBC Receive Beam
(Schedule S Beam ID: COBV)

Beam Polarization: Vertical
Peak Beam Gain: 44.3 dBi
Peak Beam G/T: 15.3 dB/K
Saturated Flux Density @ Peak Beam G/T: -101.4 to -81.4 dBW/m^2



<u>**EXHIBIT 5A-10: VBC Receive Beam**</u>
<u>**(Schedule S Beam ID: VBCH)**</u>

Beam Polarization: Horizontal
Peak Beam Gain: 44.2 dBi
Peak Beam G/T: 15 dB/K
Saturated Flux Density @ Peak Beam G/T: -103.3 to -83.3 dBW/m^2

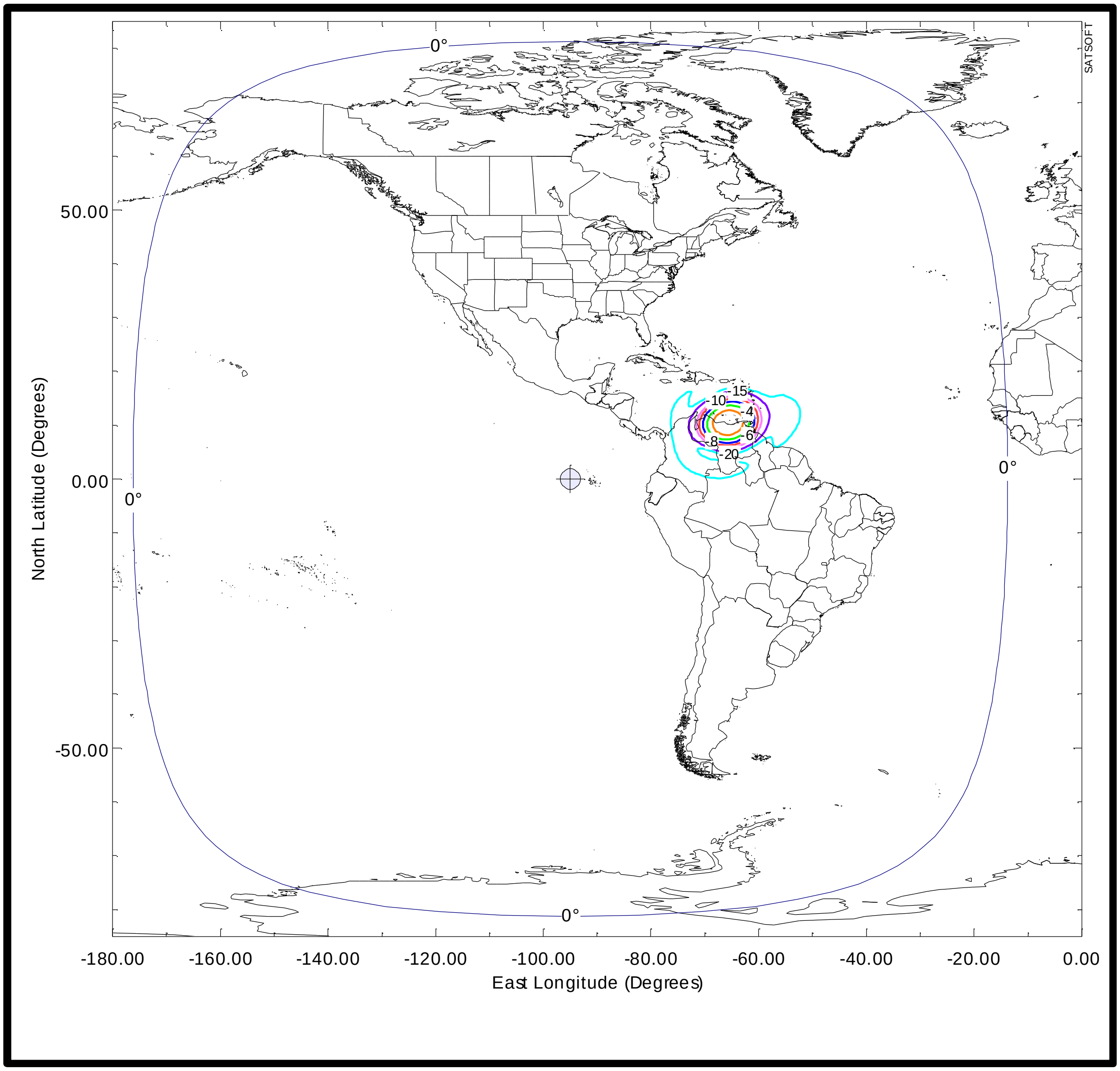


EXHIBIT 5A-11: VBC Receive Beam
(Schedule S Beam ID: VBCV)

Beam Polarization: Vertical
Peak Beam Gain: 44.2 dBi
Peak Beam G/T: 15 dB/K
Saturated Flux Density @ Peak Beam G/T: -103.3 to -83.3 dBW/m^2

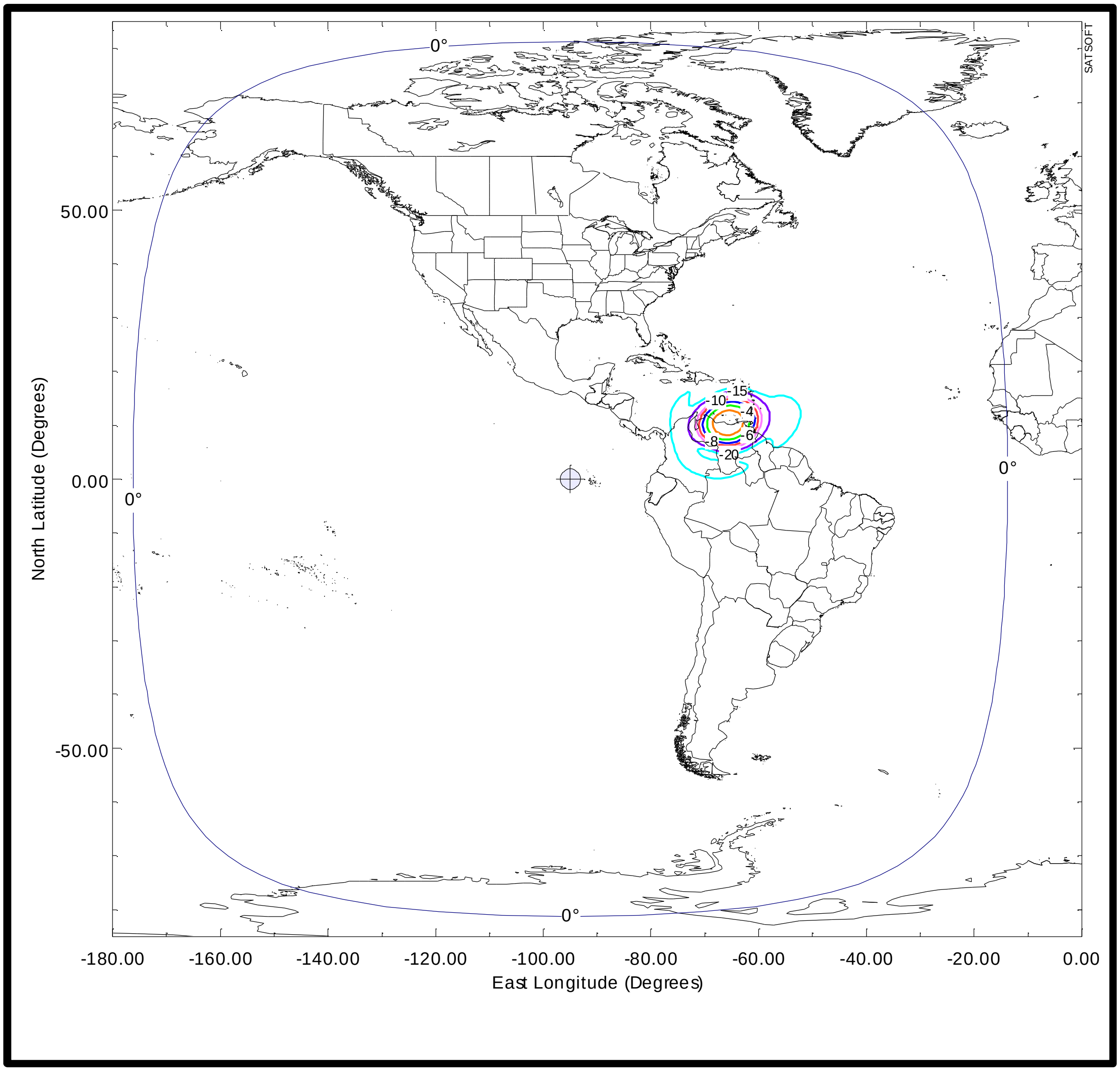


EXHIBIT 5A-12: TCN Receive Beam
(Schedule S Beam ID: TCNU)

Beam Polarization: Vertical
Peak Beam Gain: 22 dBi
Peak Beam G/T: -4.8 dB/K
Saturated Flux Density @ Peak Beam G/T: -100.6 to -80.6 dBW/m^2

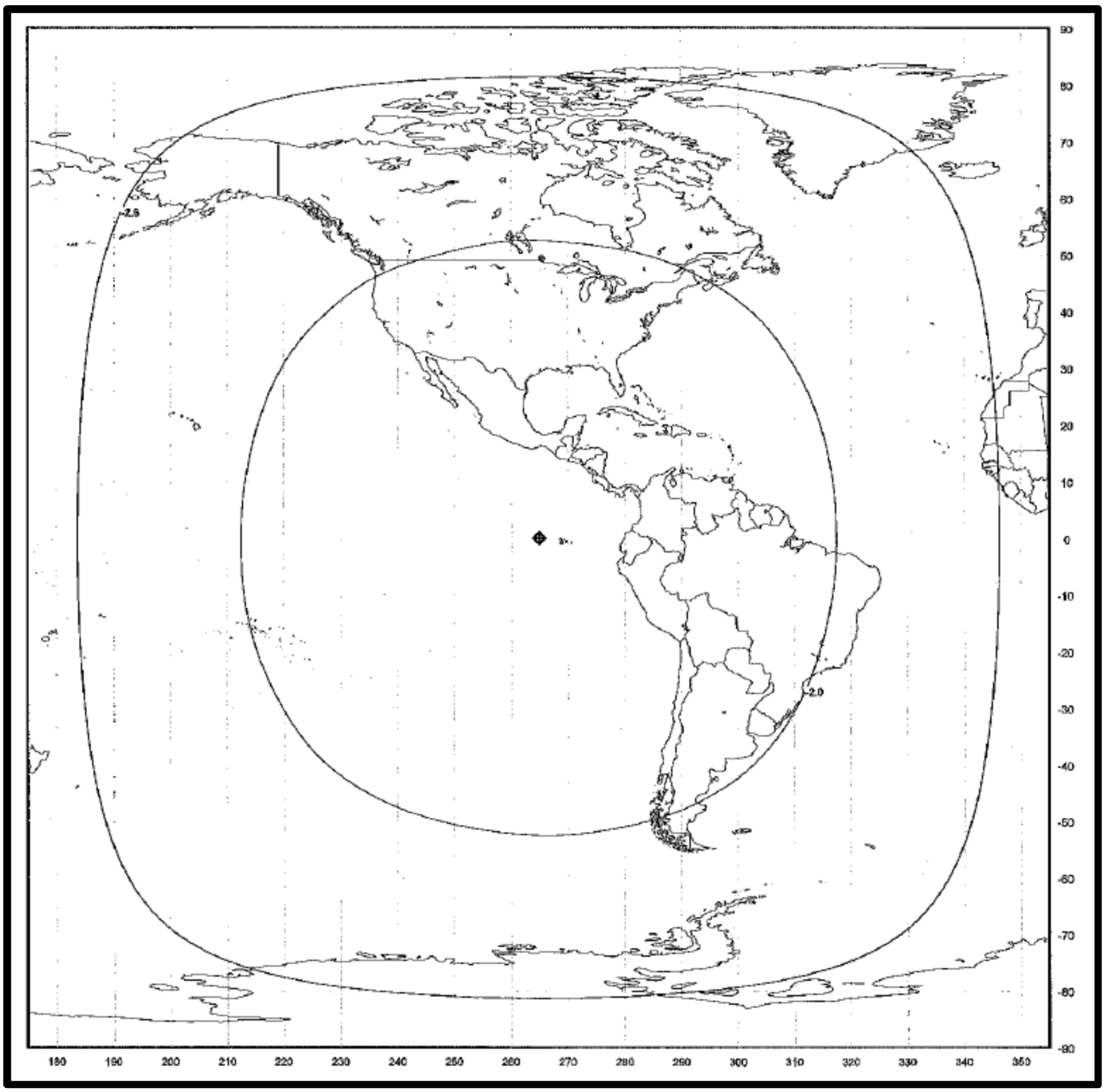
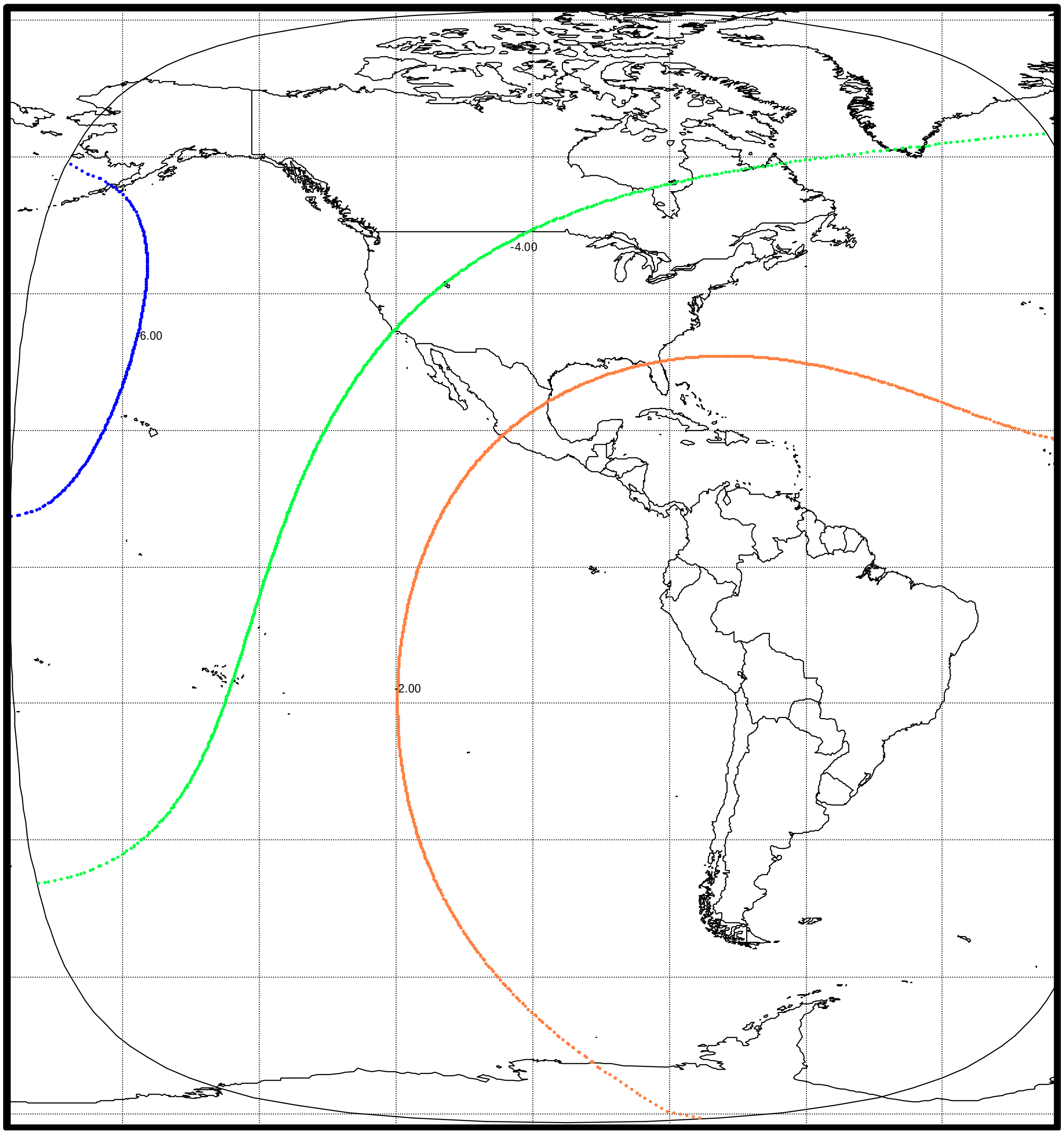


EXHIBIT 5A-13: C-band Global Transmit Beam
(Schedule S Beam ID: CBGD)

Beam Polarization: Horizontal
Peak Beam Gain: 21 dBi
Peak Beam EIRP: 37 dBW



<u>EXHIBIT 5A-14: Region 1 Transmit Beam</u>
<u>(Schedule S Beam ID: R1RD)</u>

Beam Polarization: Right Hand Circular
Peak Beam Gain: 39.3 dBi
Peak Beam EIRP: 58.3 dBW (High Power Mode)
55.5 dBW (Low Power Mode)

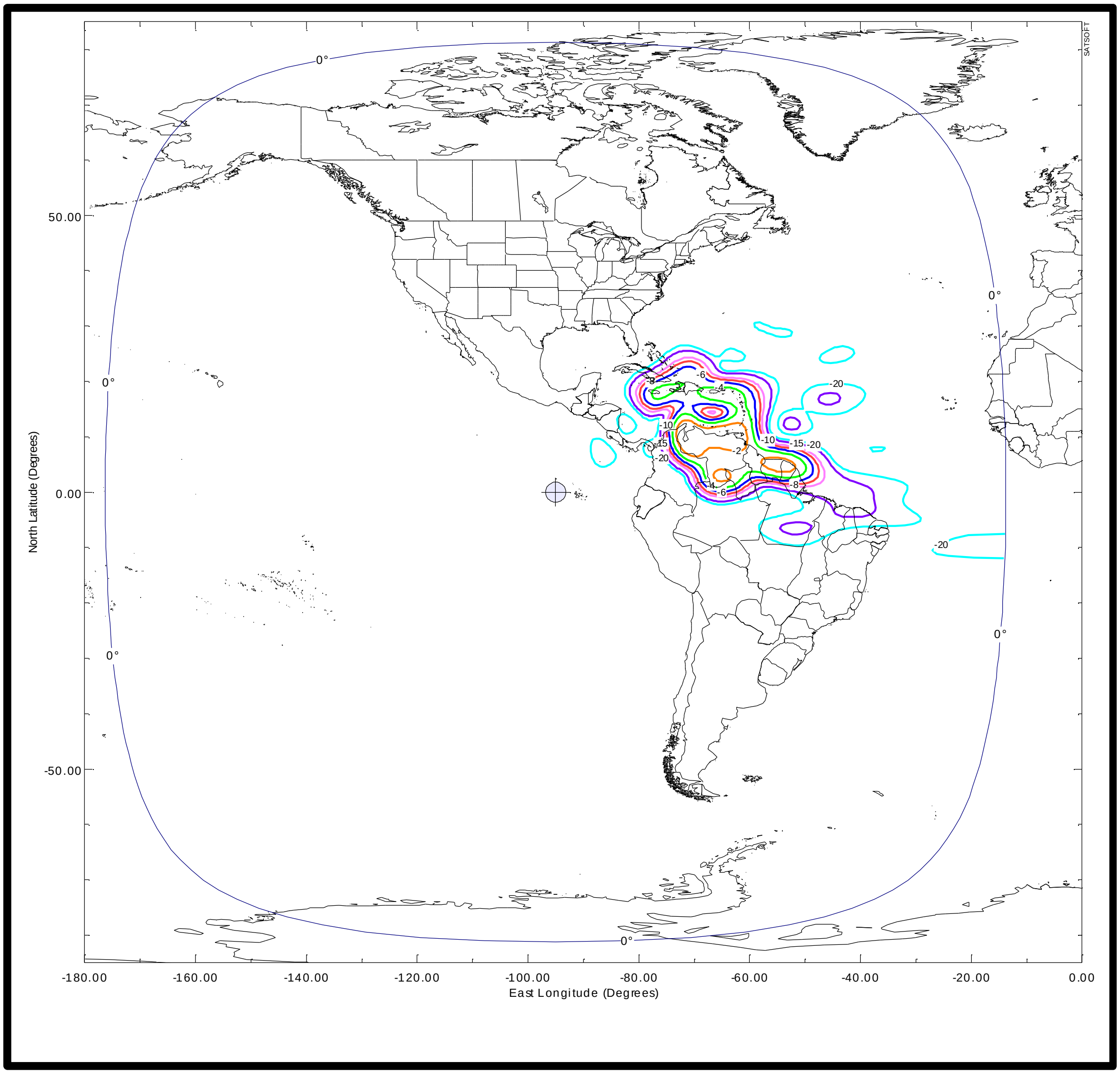


EXHIBIT 5A-15: Region 1 Transmit Beam (Schedule S Beam ID: R1LD)

Beam Polarization: Left Hand Circular
Peak Beam Gain: 39.3 dBi
Peak Beam EIRP: 58.3 dBW (High Power Mode)
55.5 dBW (Low Power Mode)

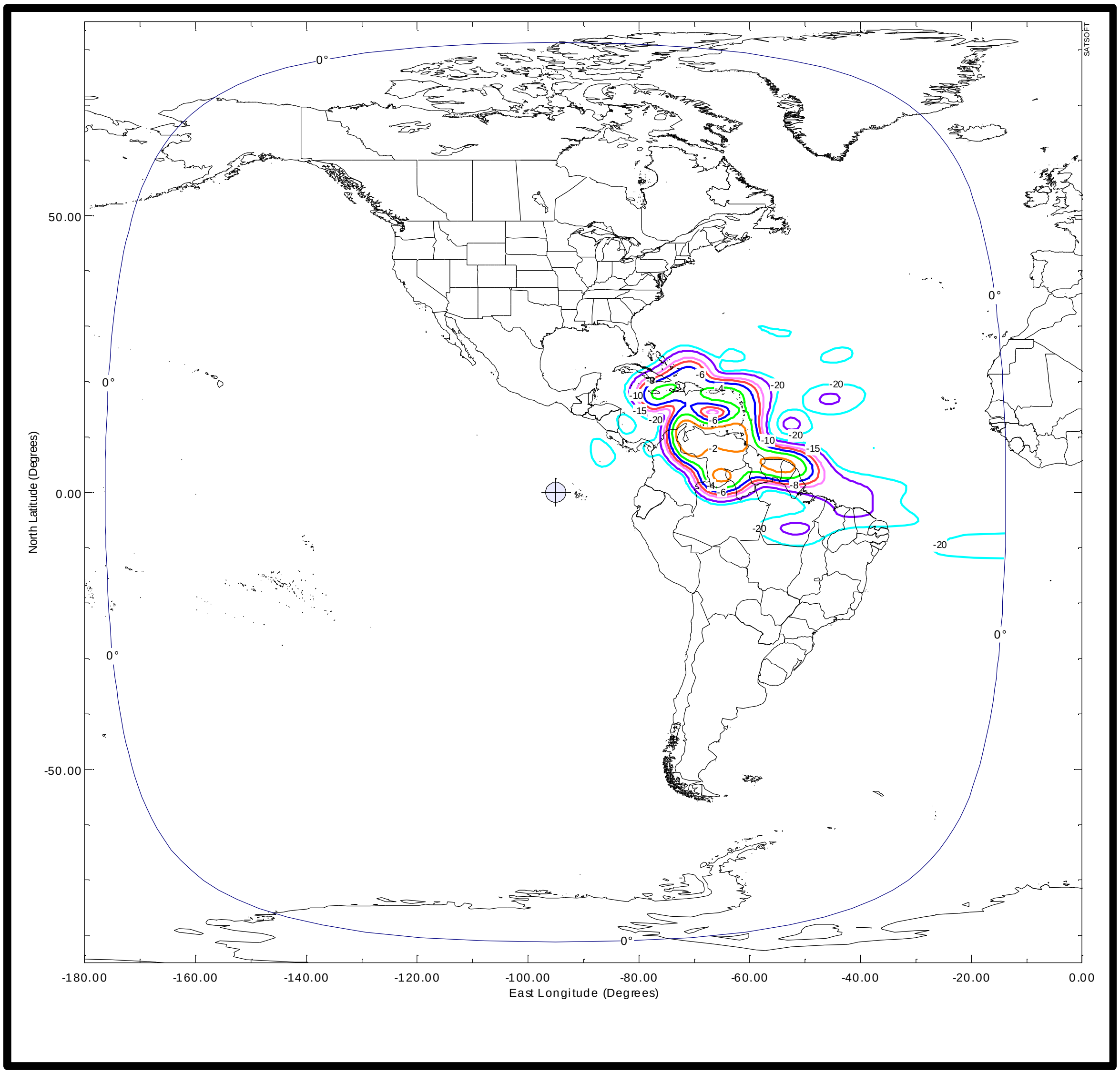


EXHIBIT 5A-16: Region 2 Transmit Beam
(Schedule S Beam ID: R2RD)

Beam Polarization: Right Hand Circular
Peak Beam Gain: 38.5 dBi
Peak Beam EIRP: 57.5 dBW (High Power Mode)
54.8 dBW (Low Power Mode)

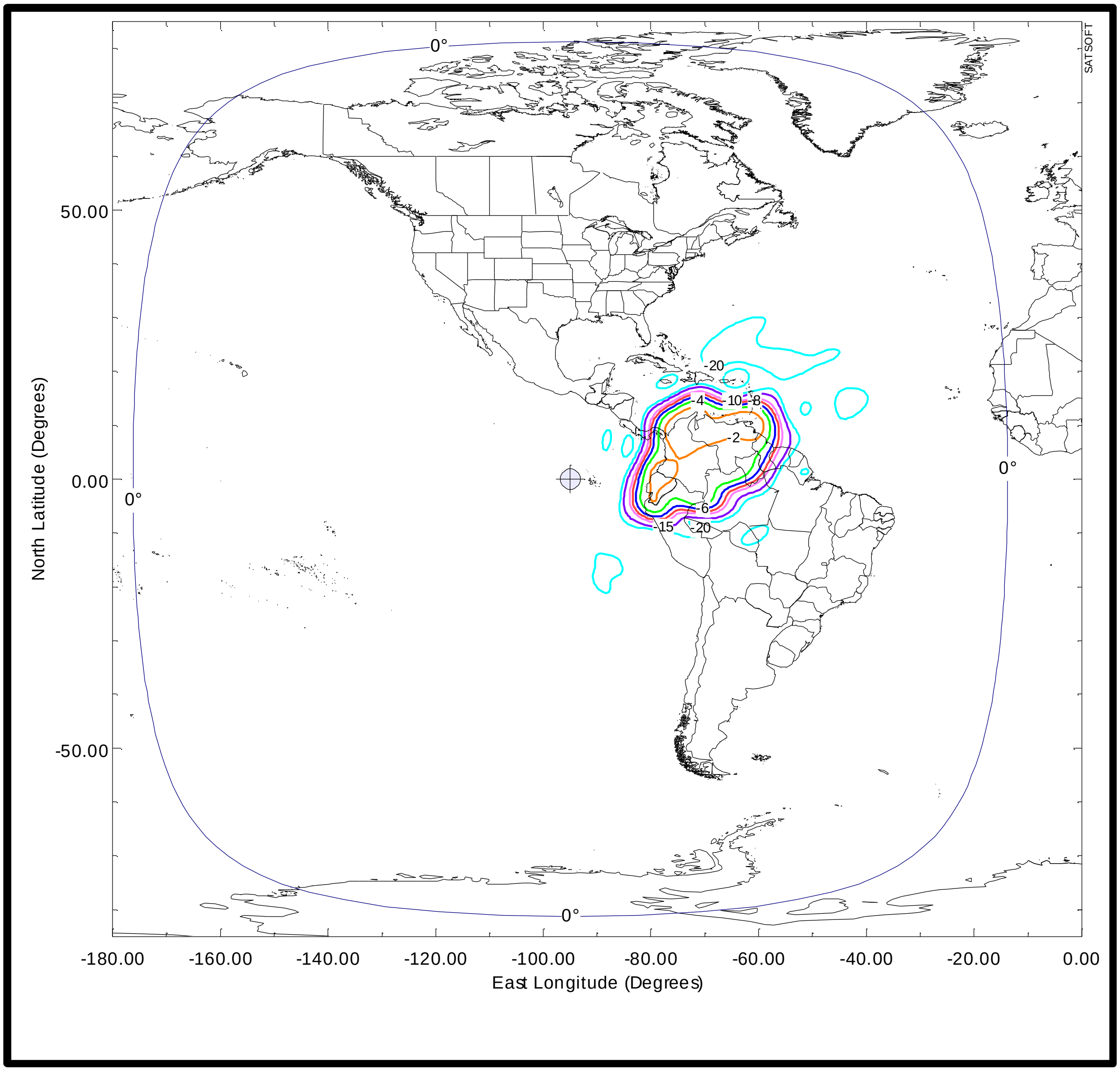


EXHIBIT 5A-17: Region 2 Transmit Beam (Schedule S Beam ID: R2LD)

Beam Polarization: Left Hand Circular
Peak Beam Gain: 38.5 dBi
Peak Beam EIRP: 57.5 dBW (High Power Mode)
54.8 dBW (Low Power Mode)

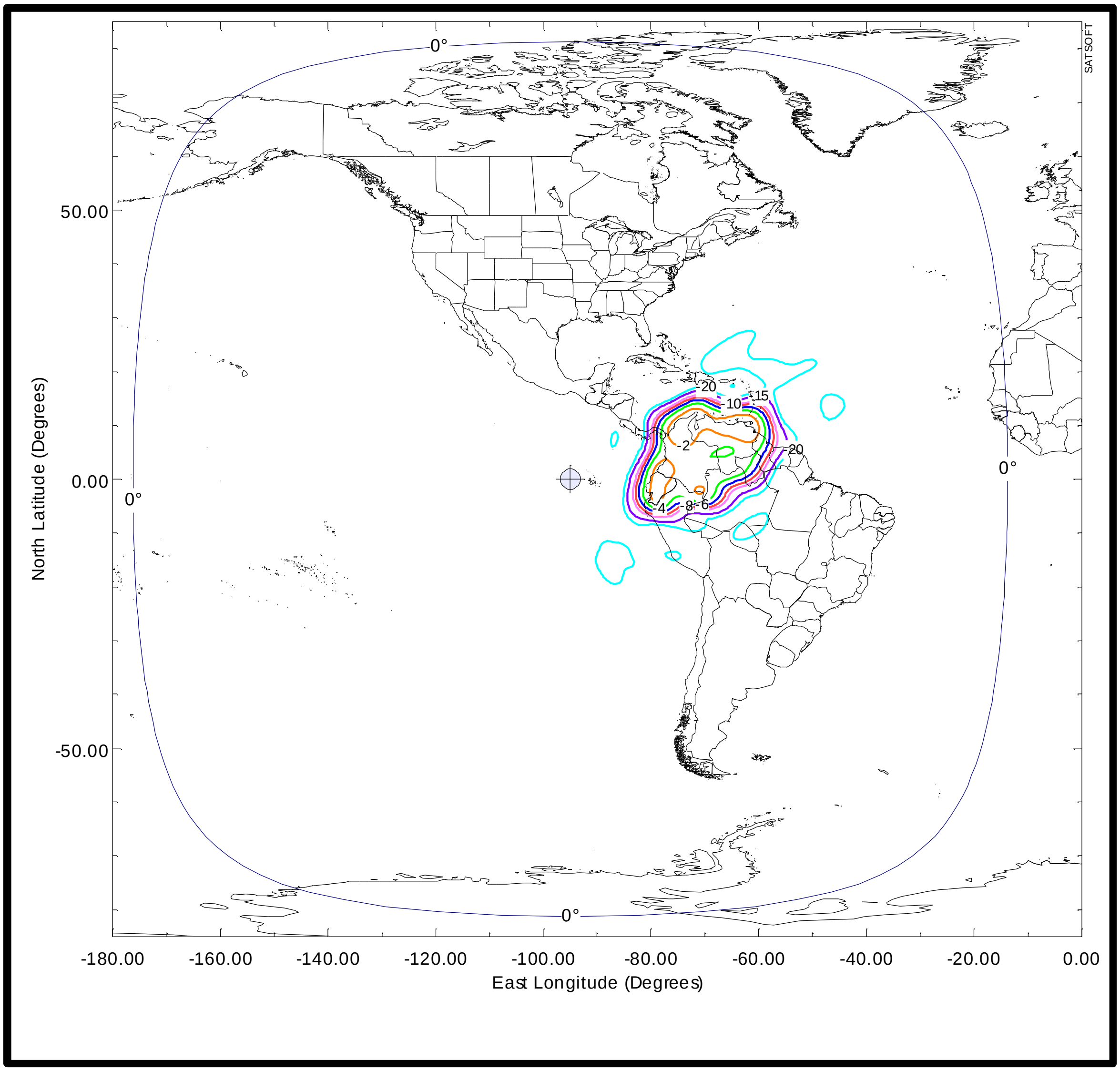


EXHIBIT 5A-18: Region 3 Transmit Beam (Schedule S Beam ID: R3RD)

Beam Polarization: Right Hand Circular
Peak Beam Gain: 37.5 dBi
Peak Beam EIRP: 58.3 dBW (High Power Mode)
Peak Beam EIRP: 55.6 dBW (Low Power Mode)

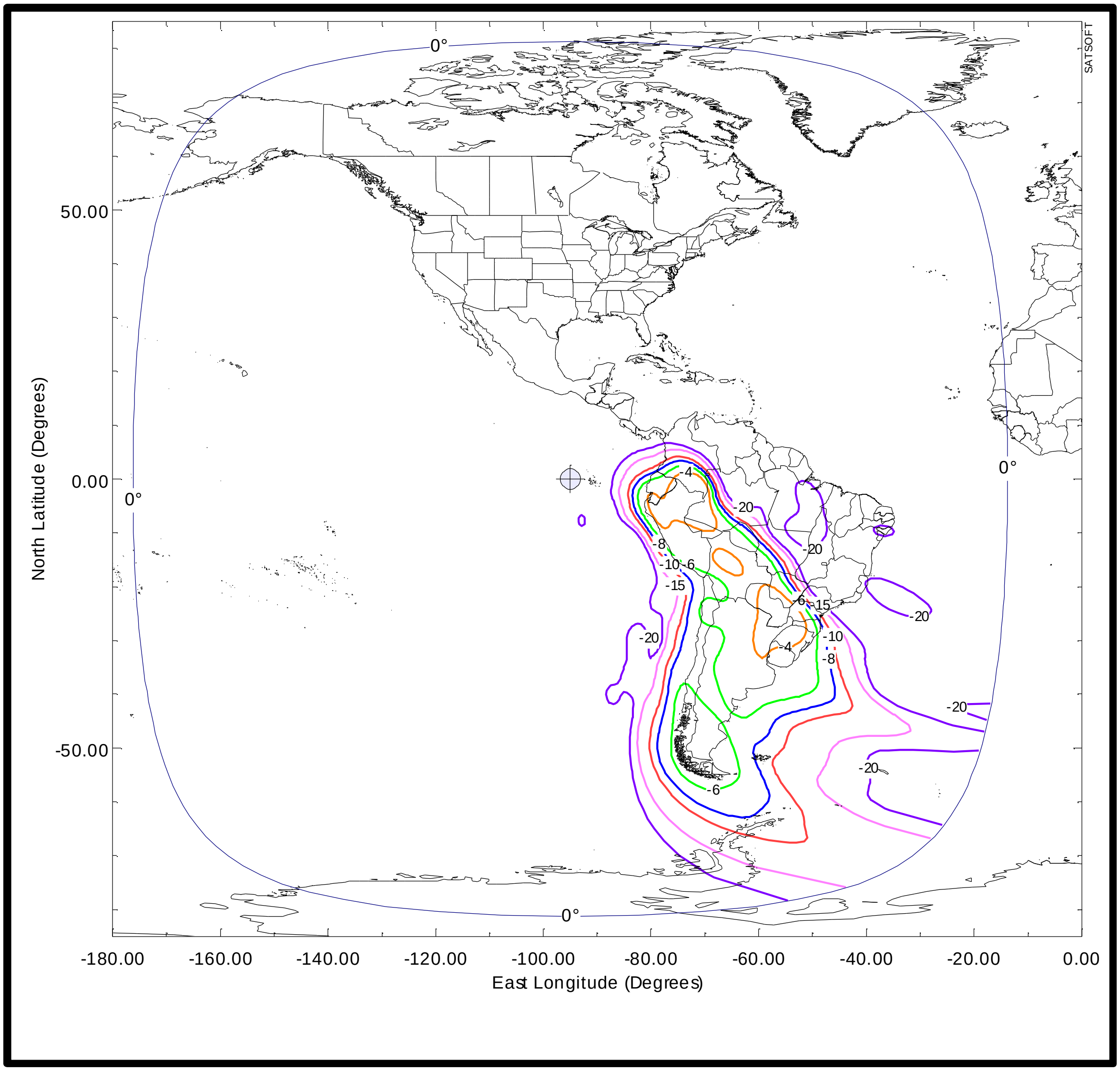


EXHIBIT 5A-19: Region 3 Transmit Beam (Schedule S Beam ID: R3LD)

Beam Polarization: Left Hand Circular
Peak Beam Gain: 37.5 dBi
Peak Beam EIRP: 55.6 dBW

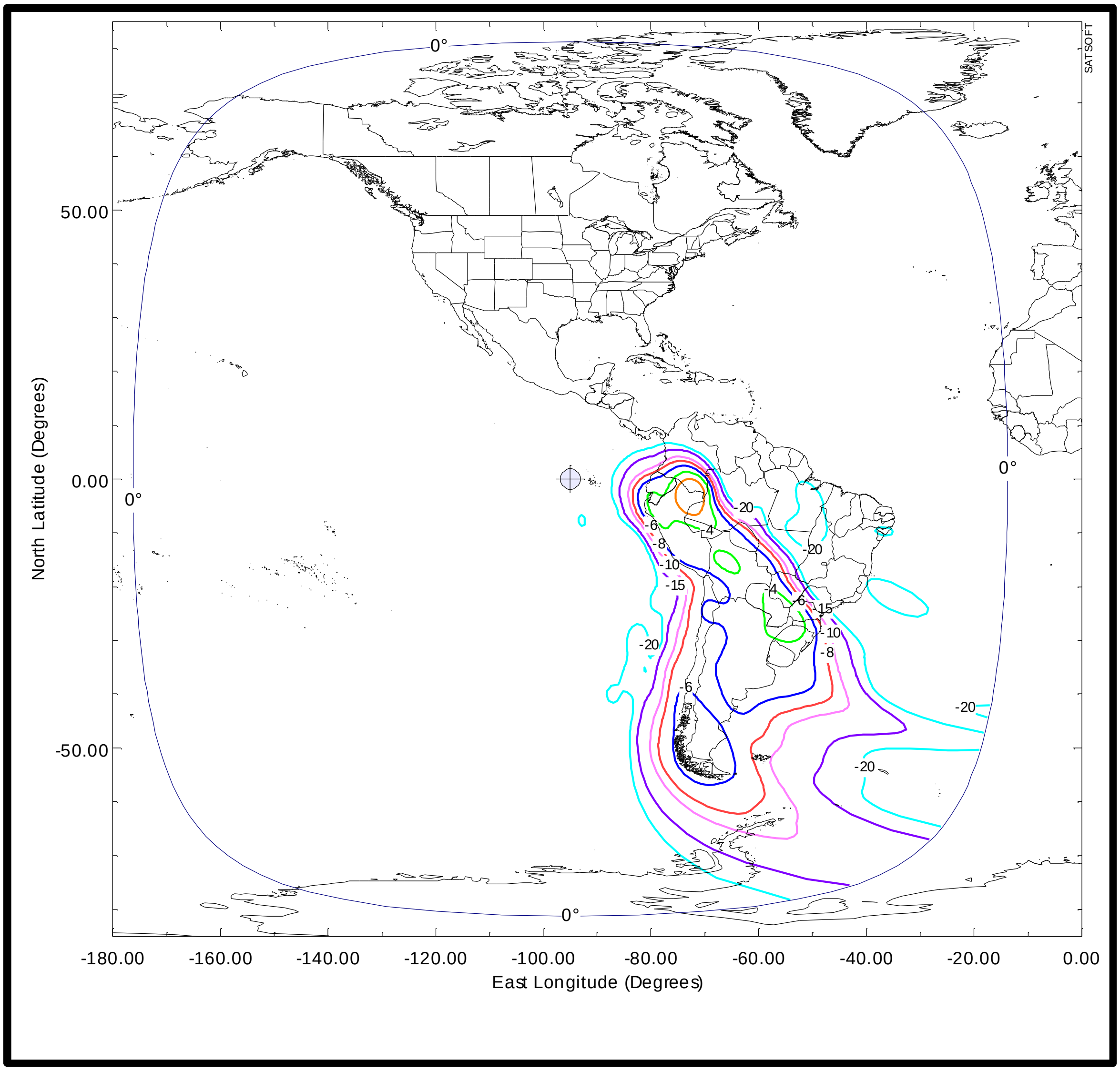


EXHIBIT 5A-20: Region 4 Transmit Beam
(Schedule S Beam ID: R4RD)

Beam Polarization: Right Hand Circular
Peak Beam Gain: 36.8 dBi
Peak Beam EIRP: 57.6 dBW (High Power Mode)
54.9 dBW (Low Power Mode)

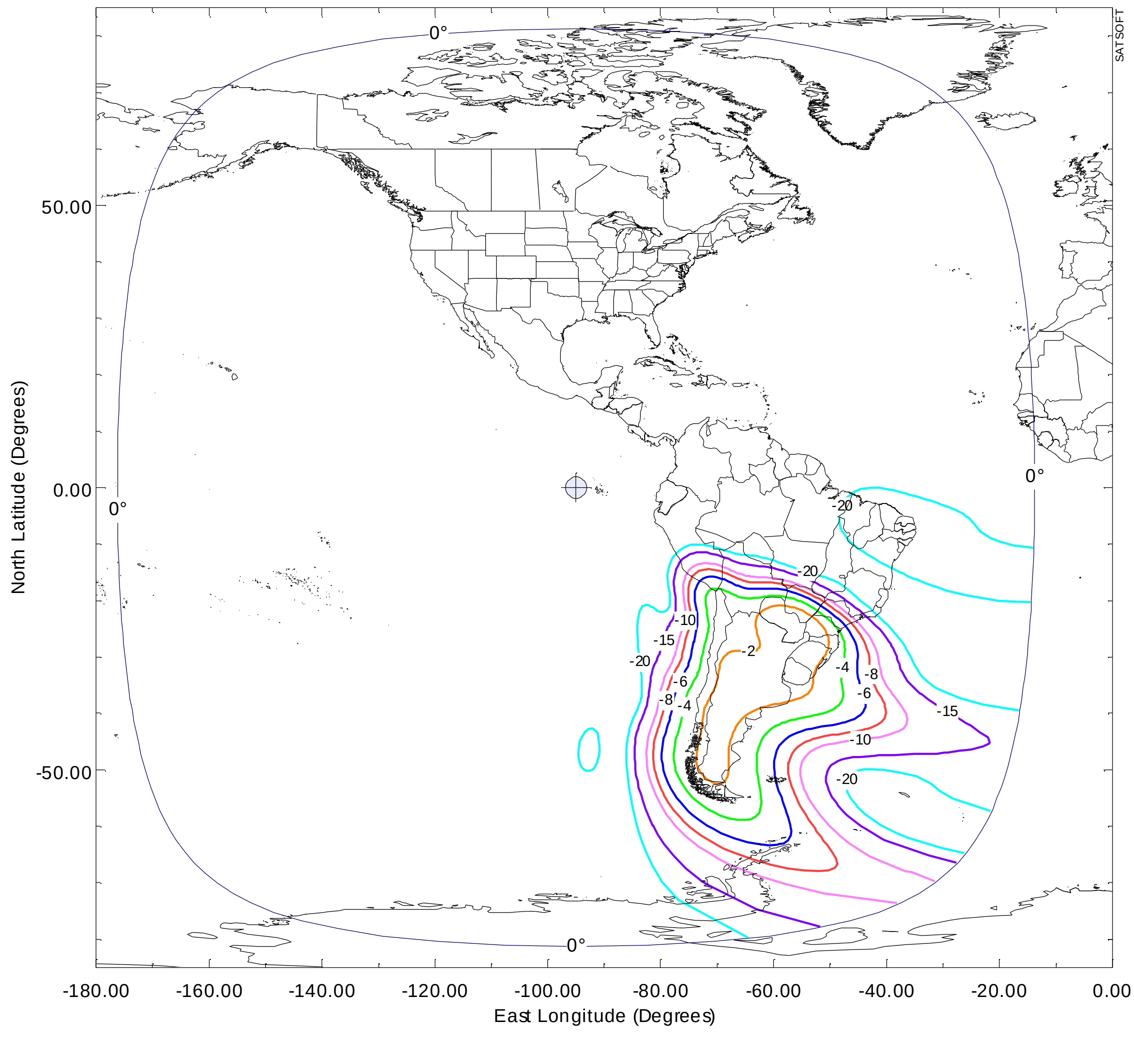
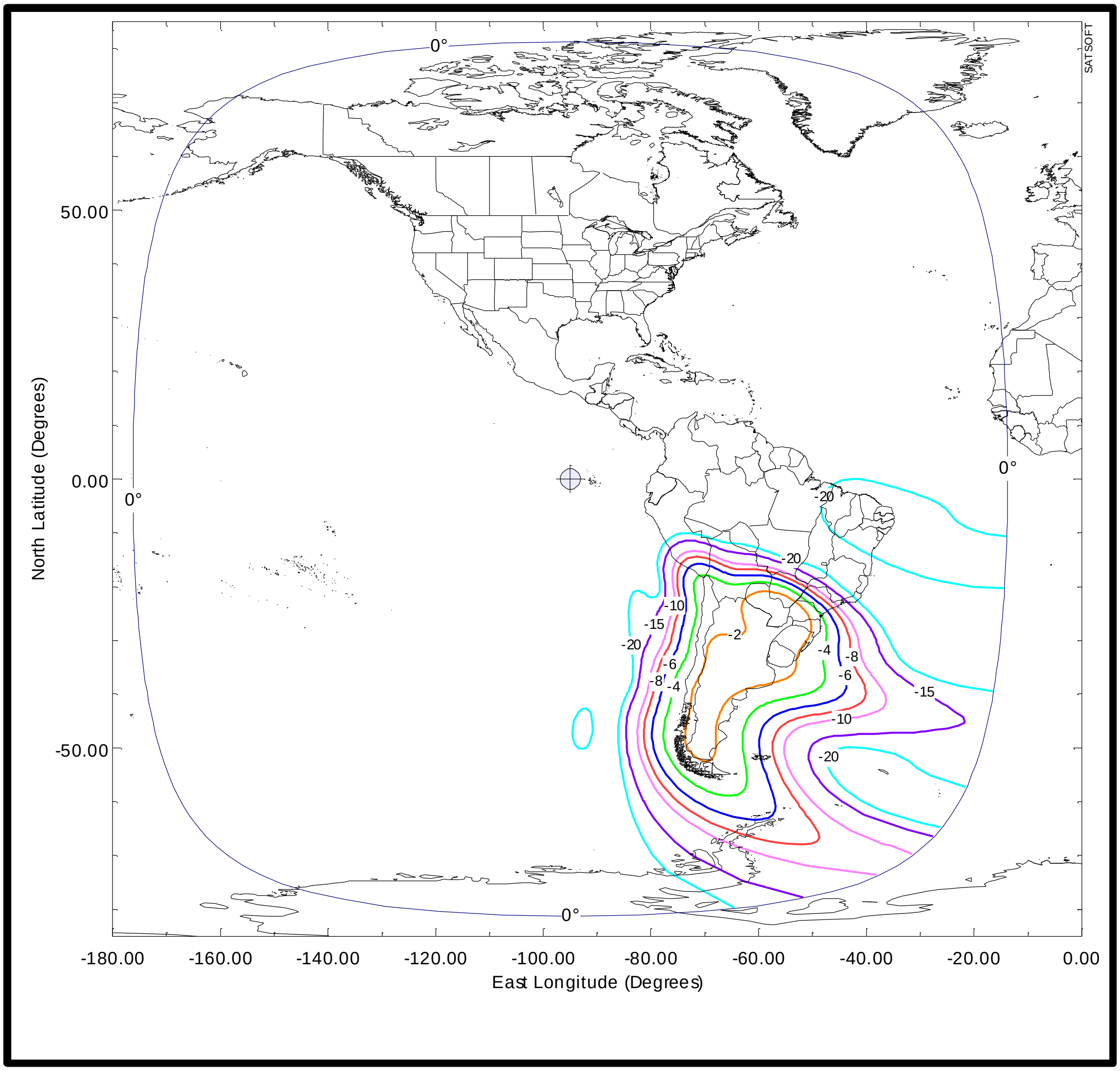


EXHIBIT 5A-21: Region 4 Transmit Beam (Schedule S Beam ID: R4LD)

Beam Polarization: Left Hand Circular
Peak Beam Gain: 36.8 dBi
Peak Beam EIRP: 54.9 dBW



<u>**EXHIBIT 5A-22: Pan Regional Transmit Beam (Schedule S Beam ID: PRRD)**</u>

Beam Polarization: Right Hand Circular
Peak Beam Gain: 39.3 dBi
Peak Beam EIRP: 60.3 dBW (High Power Mode)
57.8 dBW (Low Power Mode)

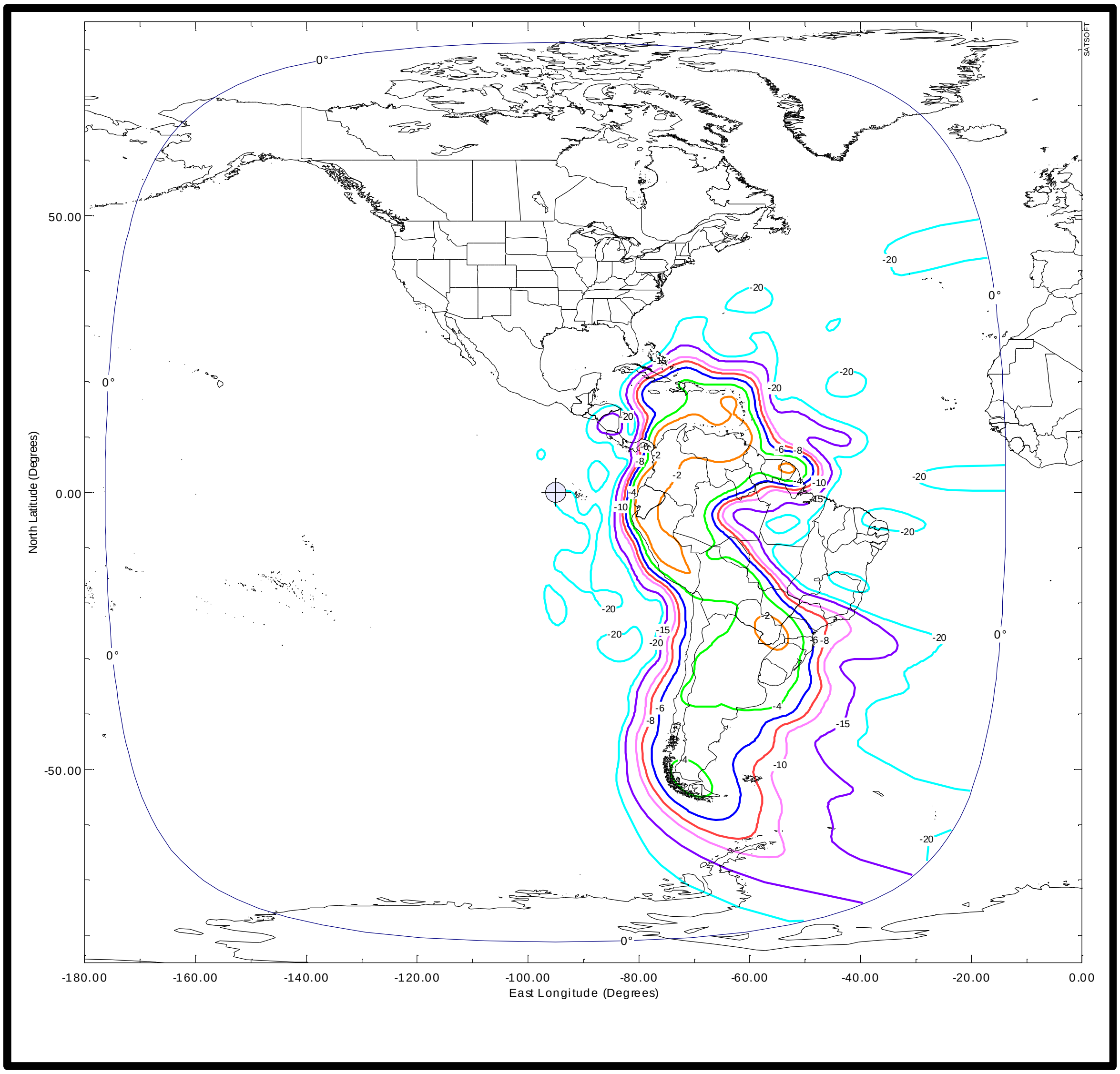


EXHIBIT 5A-23: Pan Regional Transmit Beam (Schedule S Beam ID: PRLD)

Beam Polarization: Left Hand Circular
Peak Beam Gain: 39.3 dBi
Peak Beam EIRP: 57.8 dBW

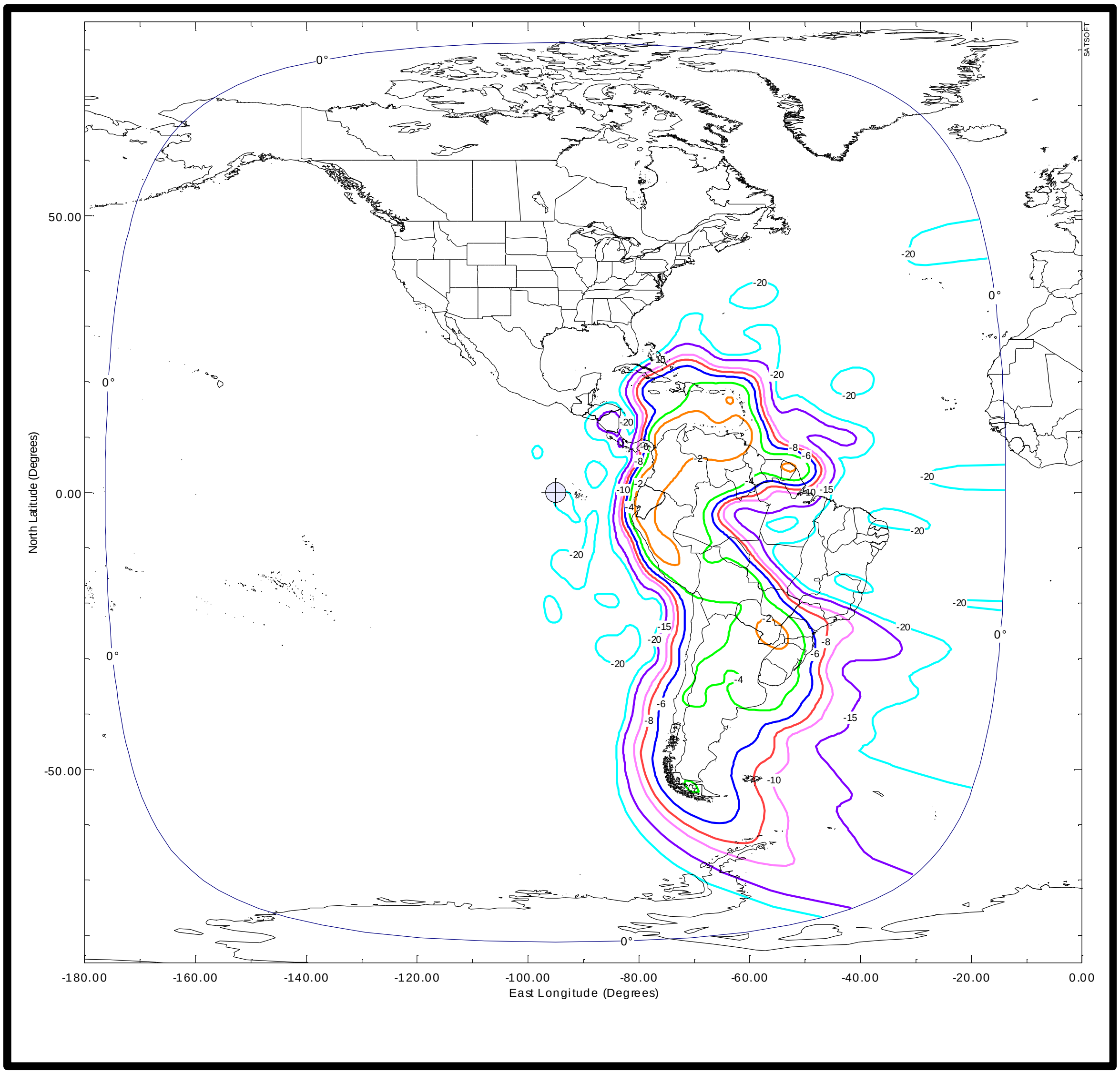


EXHIBIT 5A-24: Pan Regional Transmit Beam (Schedule S Beam ID: TCNR)

Beam Polarization: Right Hand Circular
Peak Beam Gain: 39.3 dBi
Peak Beam EIRP: 54.3 dBW

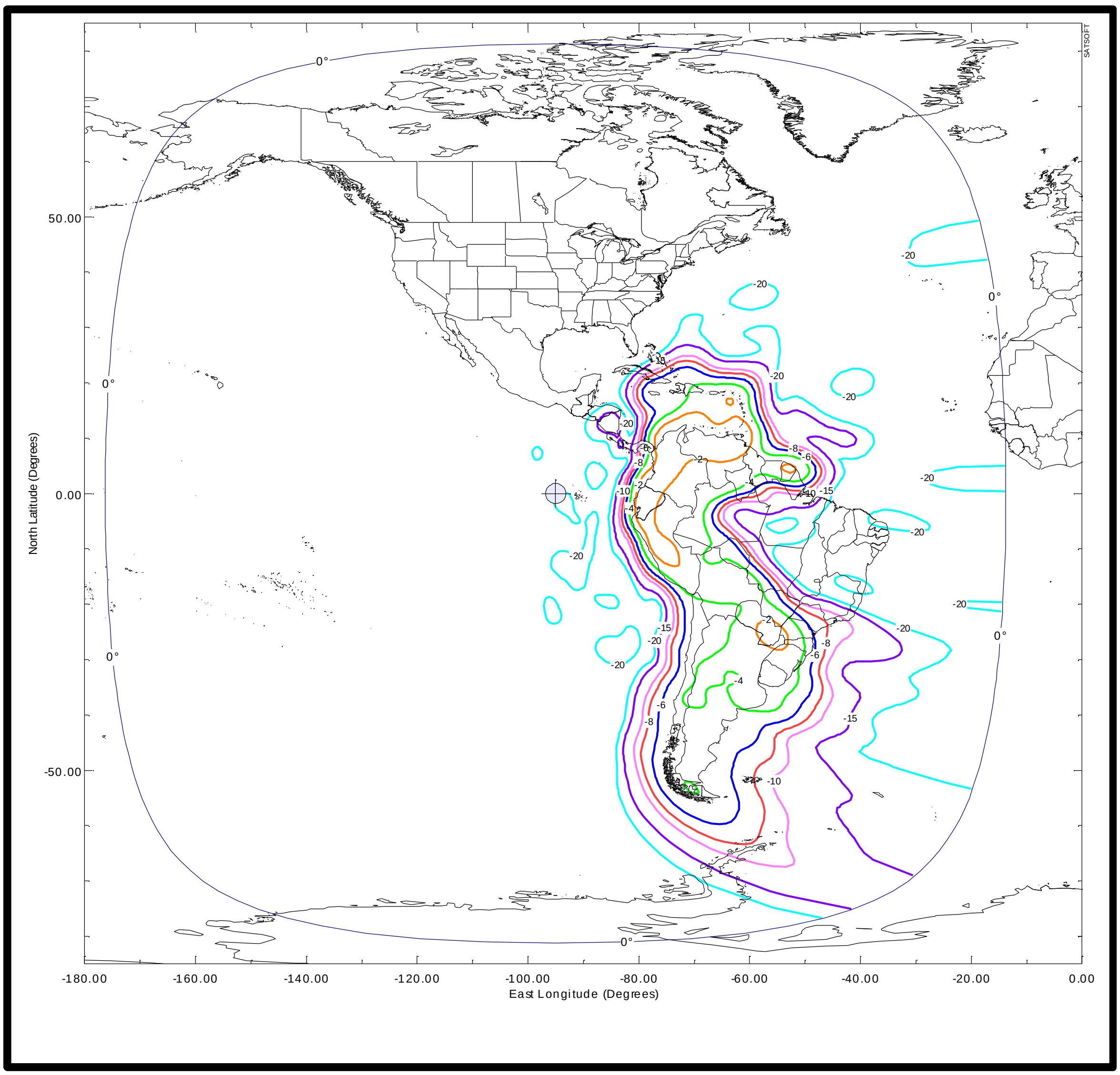


EXHIBIT 5A-25: CBC Transmit Beam (TCN Channel)
(Schedule S Beam ID: CBCR)

Beam Polarization: Right Hand Circular
Peak Beam Gain: 42.0 dBi
Peak Beam EIRP: 47.2 dBW

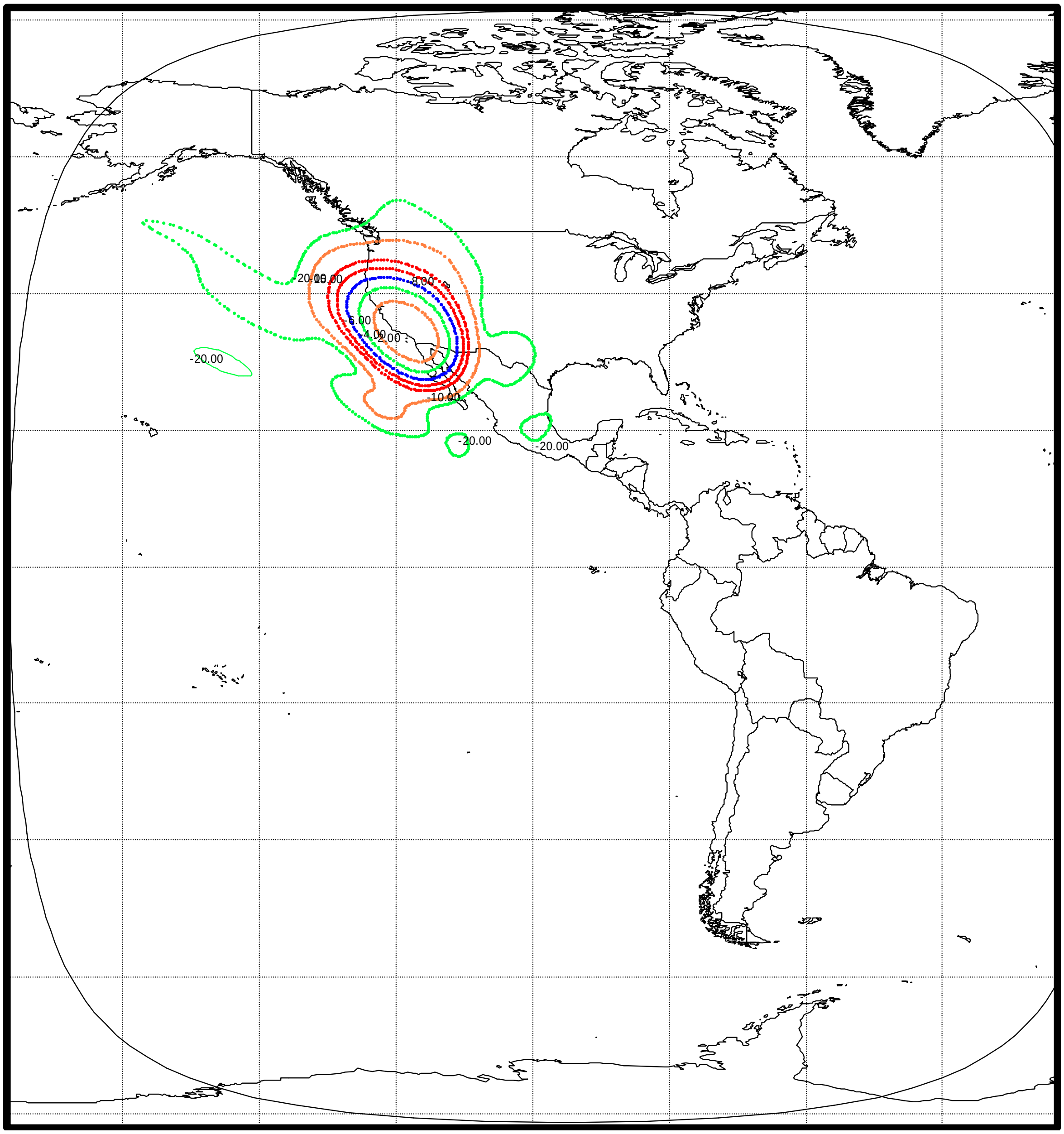


EXHIBIT 5B-1: COMMAND RECEIVE BEAM (on-station)
(Schedule S Beam ID: CMDO)

Beam Polarization: Horizontal
Peak Beam Gain: 22 dBi
Peak Beam G/T: -18.1 dB/K
Command Threshold Flux Density @ Peak Beam G/T: -108.4 dBW/m^2

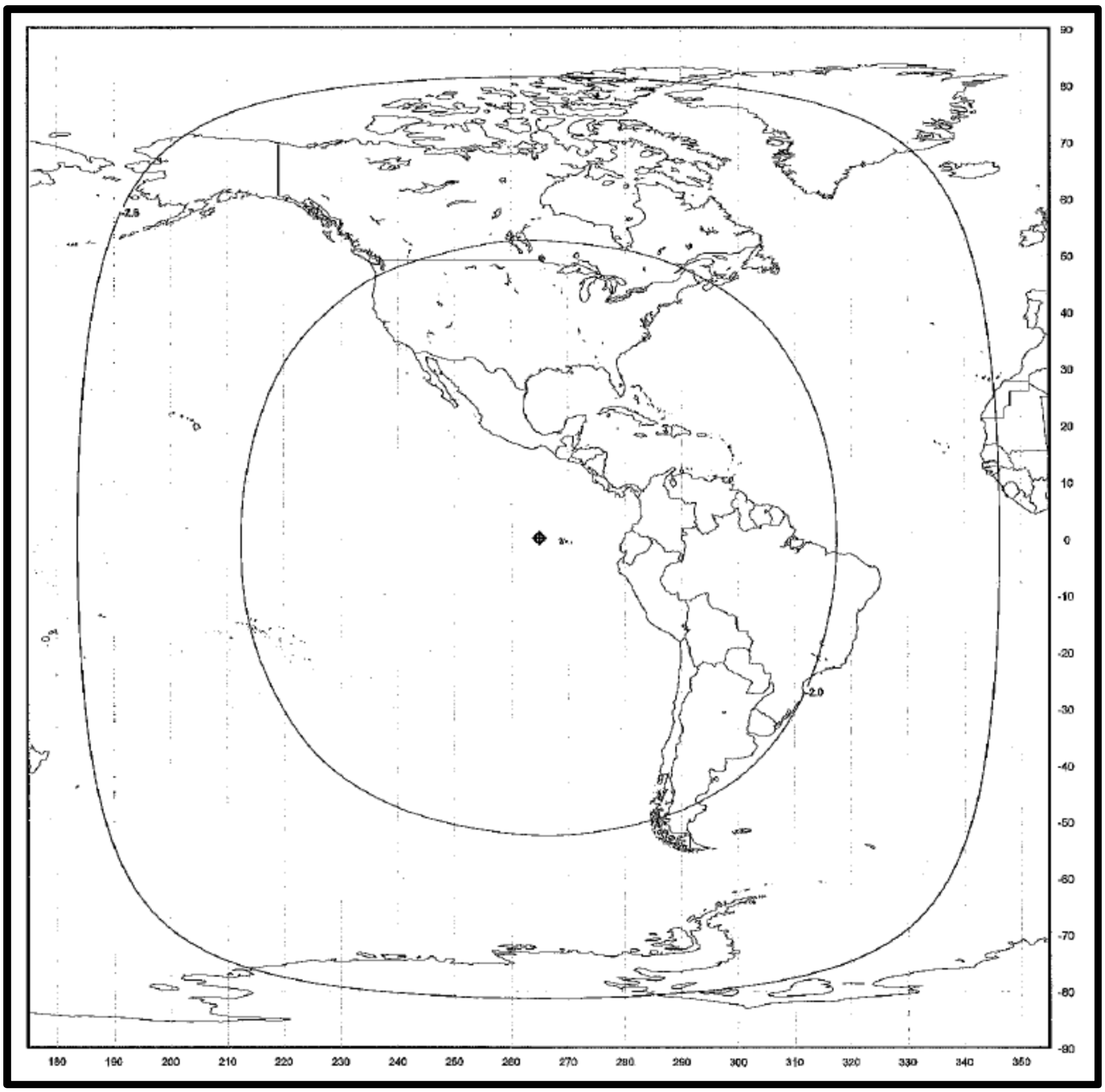


EXHIBIT 5B-2: COMMAND RECEIVE BEAM (back-up)
(+Z Antenna)
(Schedule S Beam ID: CMDF)

Beam Polarization: Left Hand Circular
Peak Beam Gain: 3 dBi
Peak Beam G/T: -32.7 dB/K
Command Threshold Flux Density @ Peak Beam G/T: -94.0 dBW/m^2

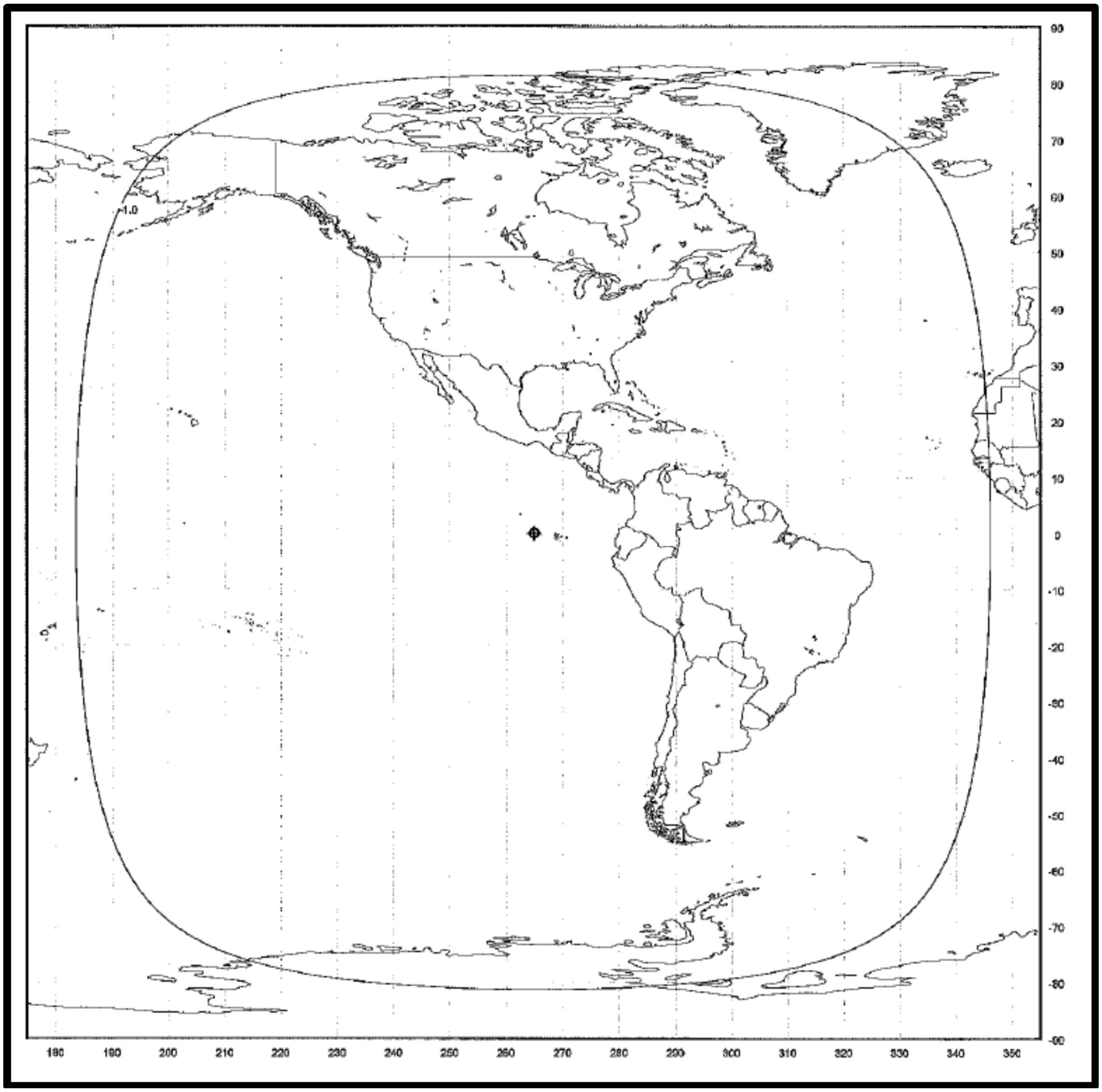


EXHIBIT 5B-3: COMMAND RECEIVE BEAM (back-up)
(-Z Antenna)
(Schedule S Beam ID: CMDA)

Beam Polarization: Left Hand Circular
Peak Beam Gain: 9 dBi
Peak Beam G/T: -32.2 dB/K
Command Threshold Flux Density @ Peak Beam G/T: -94.5 dBW/m^2

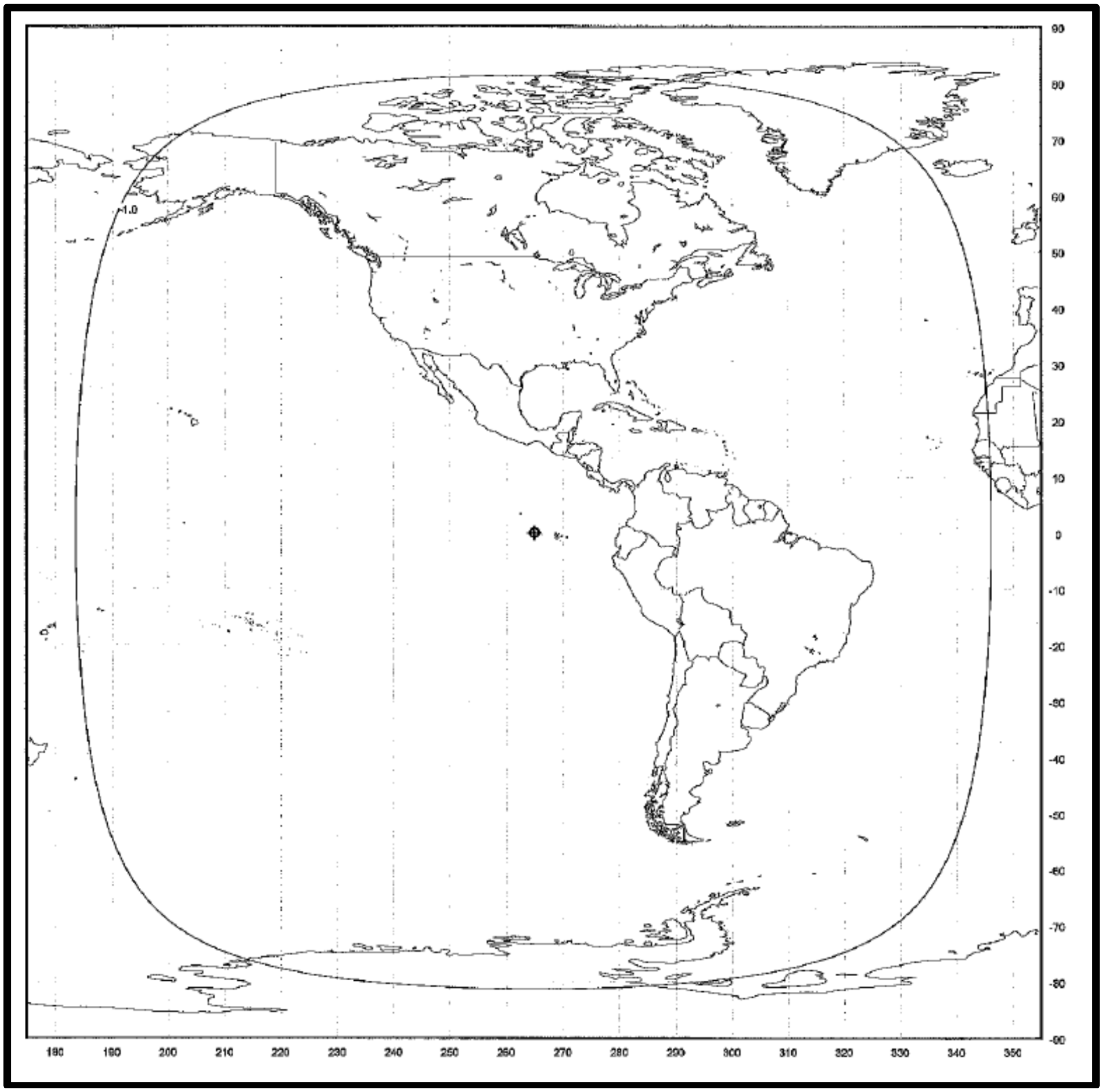


EXHIBIT 5B-4: TELEMETRY TRANSMIT BEAM (on-station)
(Schedule S Beam ID: TLMO)

Beam Polarization: Vertical
Peak Beam Gain: 22 dBi
Peak Beam EIRP: 14.2 dBW

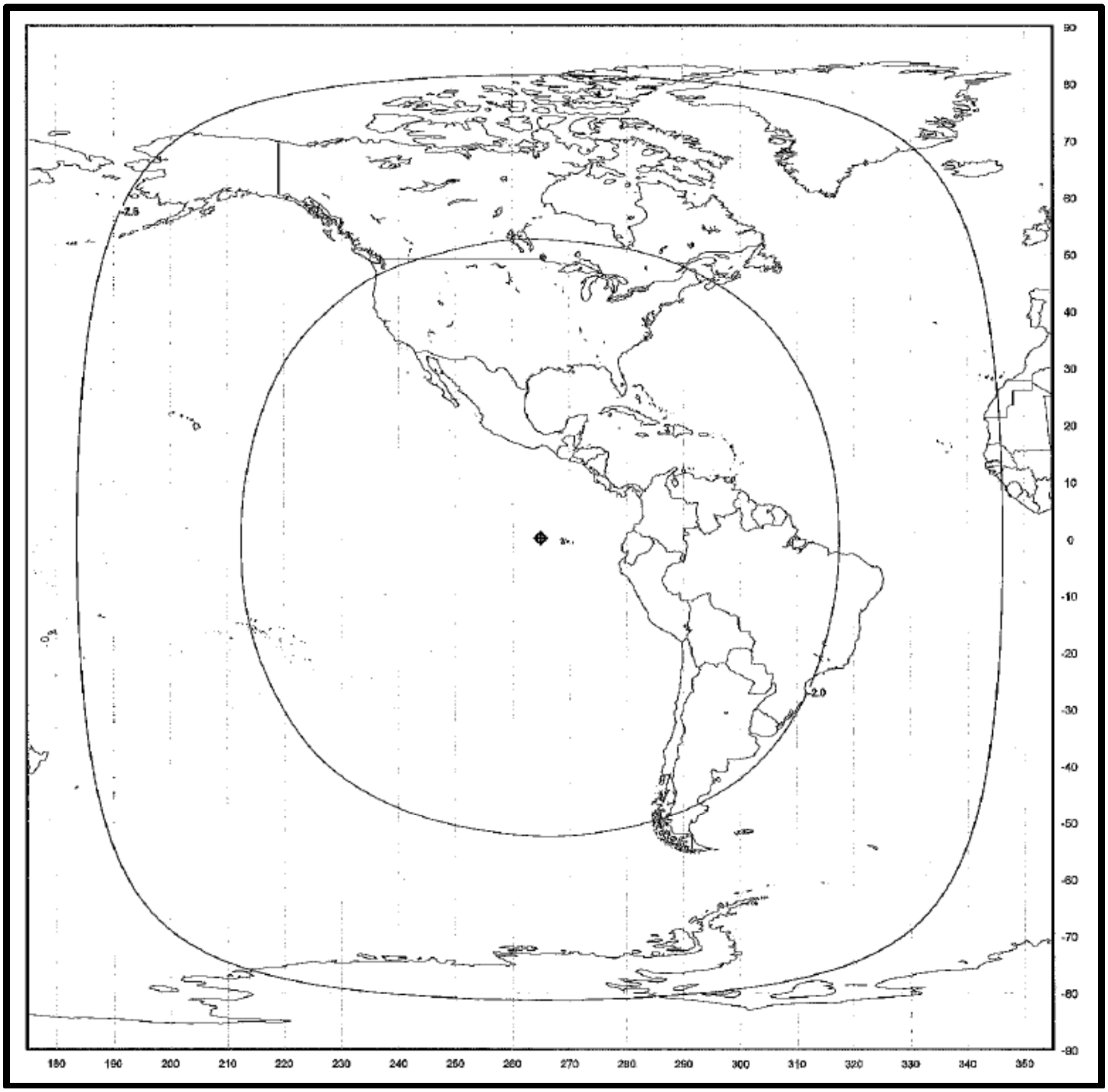


EXHIBIT 5B-5: TELEMETRY TRANSMIT BEAM (back-up)
(+Z Antenna)
(Schedule S Beam ID: TLMF)

Beam Polarization: Right Hand Circular
Peak Beam Gain: 3 dBi
Peak Beam EIRP: 15.3 dBW

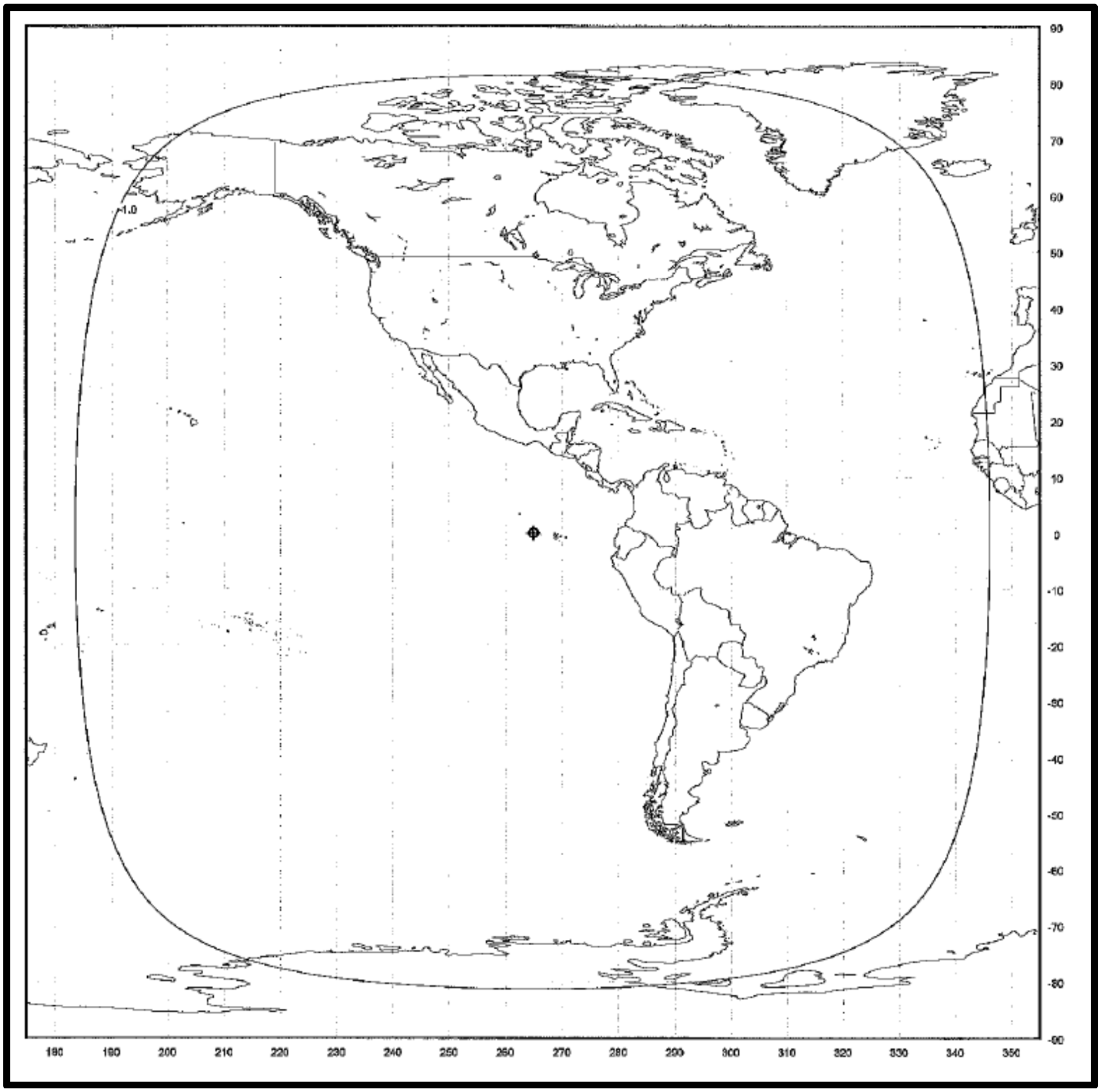


EXHIBIT 5B-6: TELEMETRY TRANSMIT BEAM (back-up)
(-Z Antenna)
(Schedule S Beam ID: TLMA)

Beam Polarization: Right Hand Circular
Peak Beam Gain: 9 dBi
Peak Beam EIRP: 16.1 dBW

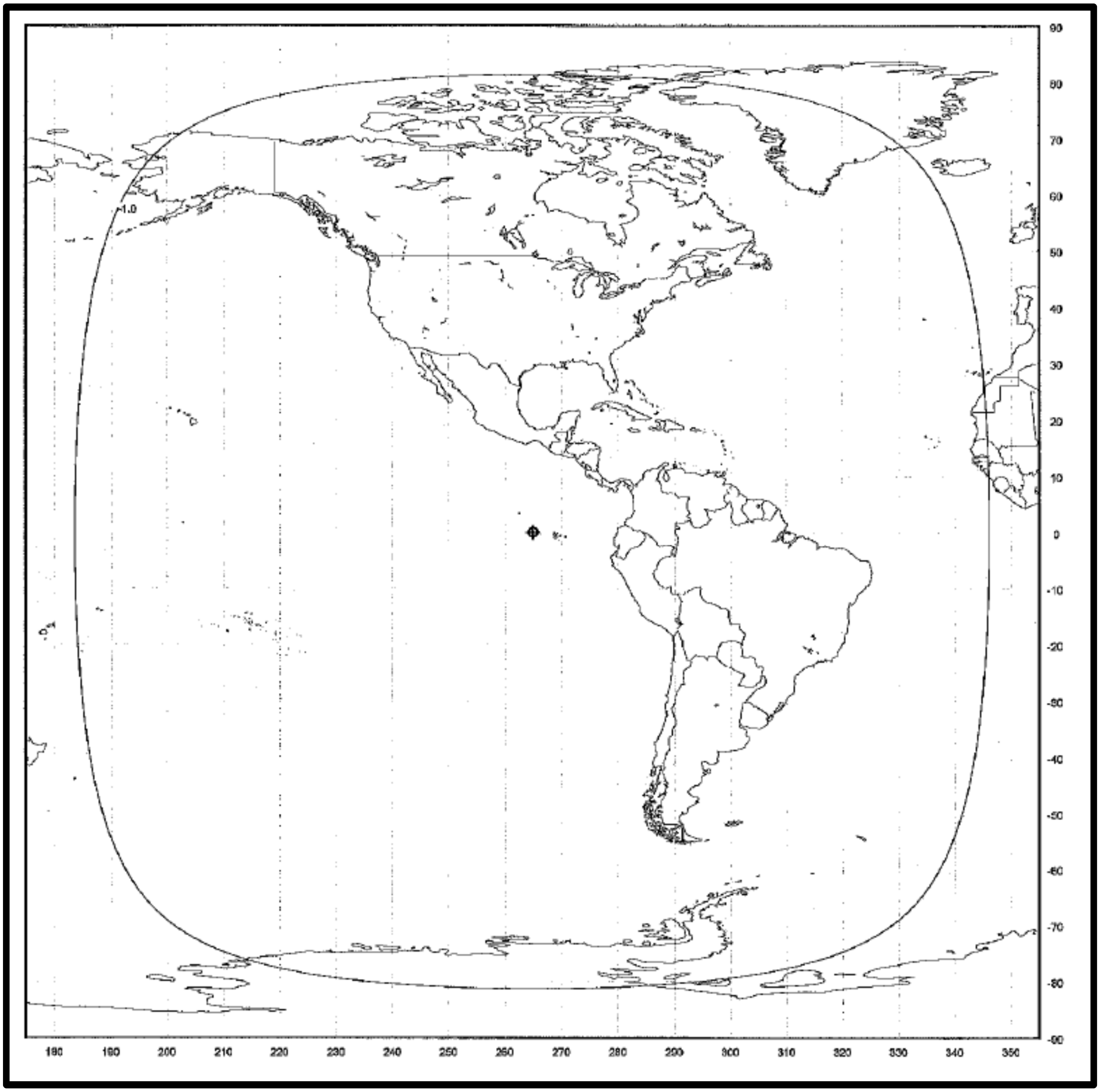


EXHIBIT 5C-1: Ku-BAND ULPC TRANSMIT BEAM
(Schedule S Beam ID: UPKR)

Beam Polarization: Right Hand Circular
Peak Beam Gain: 24 dBi
Peak Beam EIRP: 17.8 dBW

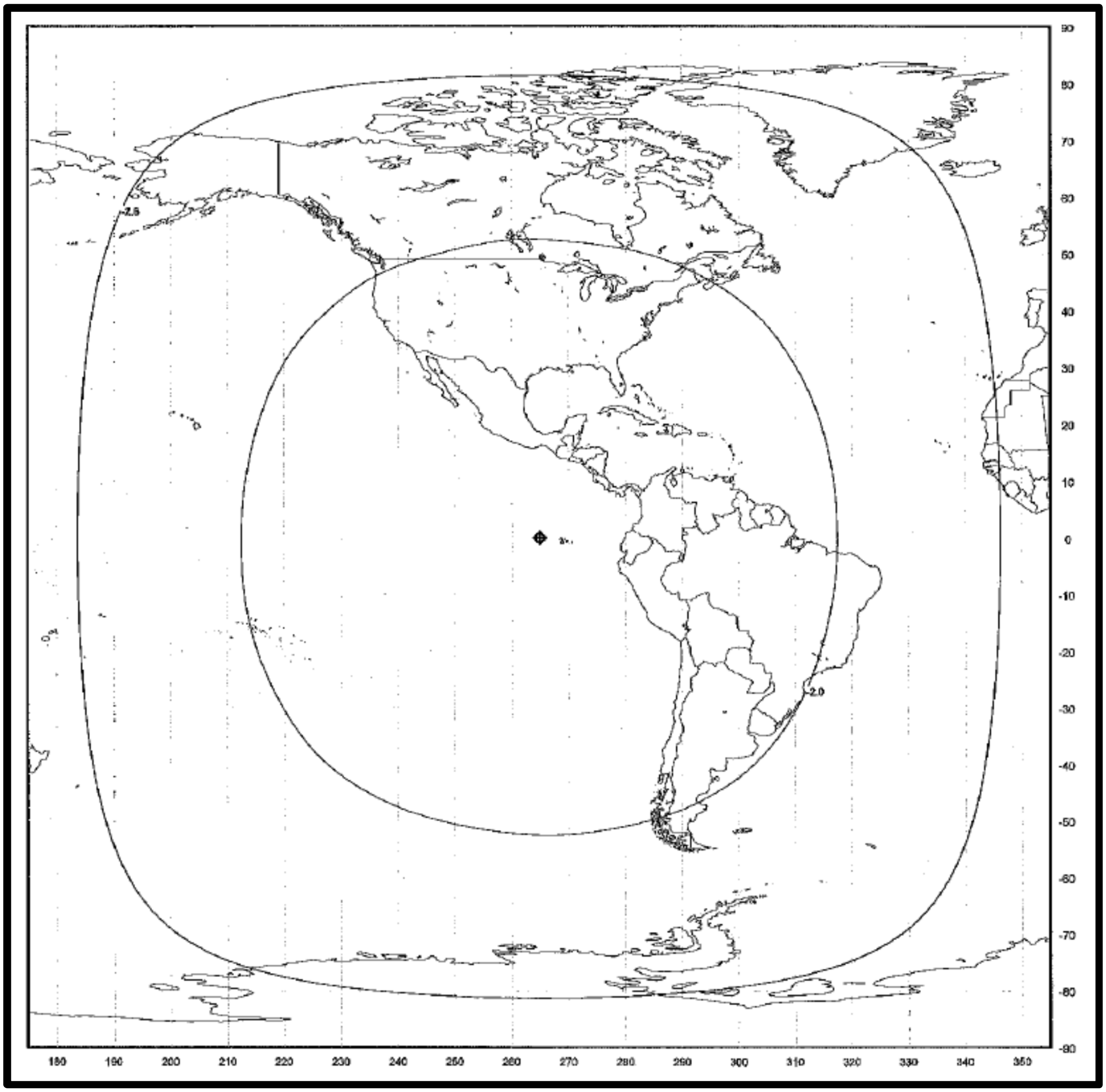


EXHIBIT 5C-2: Ku-BAND ULPC TRANSMIT BEAM
(Schedule S Beam ID: UPKL)

Beam Polarization: Left Hand Circular
Peak Beam Gain: 24 dBi
Peak Beam EIRP: 17.8 dBW

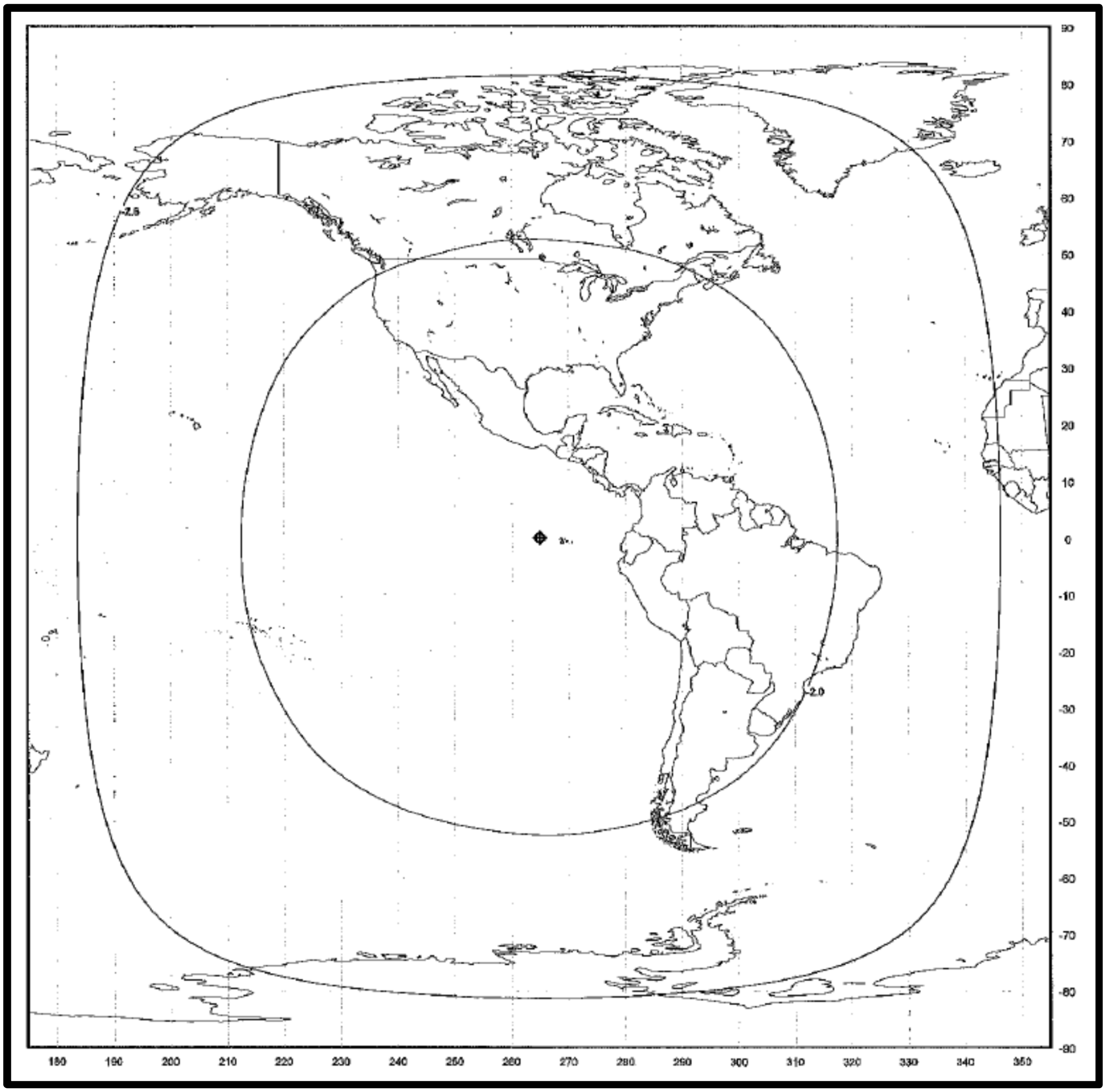


EXHIBIT 6: COMMUNICATION SUBSYSTEM EIRP AND G/T BUDGETS

Beam Name	C-Band Global	TCN	ABC	ABC
Frequency Band (MHz)	6425 – 6725	14491 – 14499	13750 – 14500	13750 – 14500
Polarization	Vertical	Vertical	Horizontal	Vertical
Channel Bandwidth (MHz)	69.6	8	24 / 36	24 / 36
Antenna Noise Temperature (°Kelvin)	290	133	290	290
Receiver Noise Temperature (°Kelvin)	474	345	591	591
Total System Noise Temperature (°Kelvin)	764	478	881	881
Total System Noise Temperature (dB/K)	28.8	26.8	29.5	29.5
Peak Gain of Satellite Receive Antenna (dBi)	21.0	22.0	44.1	44.1
Peak G/T (dB/K)	-7.8	-4.8	14.7	14.7
Minimum SFD [G/T: Peak, Attn: 0 dB] -- (dBW/m^2)	-100	-100.6	-101.4	-101.4
Beam Name	BBC	BBC	CBC	CBC
-Frequency Band (MHz)	13750 – 14500	13750 – 14500	13750 – 14000	13750 – 14000
Polarization	Horizontal	Vertical	Horizontal	Vertical
Channel Bandwidth (MHz)	24 / 36	24 / 36	24	24
Antenna Noise Temperature (°Kelvin)	290	290	290	290
Receiver Noise Temperature (°Kelvin)	532	532	527	527
Total System Noise Temperature (°Kelvin)	822	822	817	817
Total System Noise Temperature (dB/K)	29.1	29.1	29.1	29.1
Peak Gain of Satellite Receive Antenna (dBi)	44.3	44.3	43.2	43.2
Peak G/T (dB/K)	15.2	15.2	14.1	14.1
Minimum SFD [G/T: Peak, Attn: 0 dB] -- (dBW/m^2)	-100.2	-100.2	-99.3	-99.3
Beam Name	CoBC	CoBC	VBC	VBC
Frequency Band (MHz)	13750 – 14500	13750 – 14500	13750 – 14500	13750 – 14500
Polarization	Horizontal	Vertical	Horizontal	Vertical
Channel Bandwidth (MHz)	24 / 36	24 / 36	24 / 36	24 / 36
Antenna Noise Temperature (°Kelvin)	290	290	290	290
Receiver Noise Temperature (°Kelvin)	503	503	540	540
Total System Noise Temperature (°Kelvin)	793	793	830	830
Total System Noise Temperature (dB/K)	29.0	29.0	29.2	29.2
Peak Gain of Satellite Receive Antenna (dBi)	44.3	44.3	44.2	44.2
Peak G/T (dB/K)	15.3	15.3	15.0	15.0
Minimum SFD [G/T: Peak, Attn: 0 dB] -- (dBW/m^2)	-101.4	-101.4	-103.3	-103.3

EXHIBIT 6: COMMUNICATION SUBSYSTEM EIRP AND G/T BUDGETS (continued)

Beam Name	C-Band Global	TCN/Pan Regional	TCN/CBC	
Frequency Band (MHz)	3400 – 3700	11456 – 11464	11456 – 11464	
Polarization	Horizontal	Right Hand Circular	Right Hand Circular	
Channel Bandwidth (MHz)	69.6	8	8	
Maximum Power At The Output of Last Stage Amplifier (dBW)	18.1	19.8	19.8	
Loss From Last Stage Amplifier To Transmit Antenna Interface (dB)	2.1	4.8	14.6	
Power Into Transmit Antenna (dBW)	16.0	15.0	5.2	
Power Into Transmit Antenna (Watts)	39.7	31.8	3.3	
Peak Gain of Satellite Transmit Antenna (dBi)	21.0	39.3	42.0	
Maximum Downlink EIRP (dBW)	37.0	54.3	47.2	
Beam Name	Pan Regional (High Power Mode)	Pan Regional (Low Power Mode)	Pan Regional (Low Power Mode)	Pan Regional
Frequency Band (MHz)	11450 – 11700	11450 – 11700	11948 – 11950	11450 – 11700 11950 – 11950
Polarization	Right Hand Circular	Right Hand Circular	Right Hand Circular	Left Hand Circular
Channel Bandwidth (MHz)	24	24	24	24
Maximum Power At The Output of Last Stage Amplifier (dBW)	24.7	21.7	21.7	21.7
Loss From Last Stage Amplifier To Transmit Antenna Interface (dB)	3.7	3.2	3.2	3.2
Power Into Transmit Antenna (dBW)	21.0	18.5	18.5	18.5
Power Into Transmit Antenna (Watts)	125.9	70.8	70.8	70.8
Peak Gain of Satellite Transmit Antenna (dBi)	39.3	39.3	39.3	39.3
Maximum Downlink EIRP (dBW)	60.3	57.8	57.8	57.8
Beam Name	Region 1 (Low Power Mode)	Region 1 (High Power Mode)	Region 1 (Low Power Mode)	
Frequency Band (MHz)	10950 – 11200	11700 – 11950	11700 – 11950	
Polarization	Right Hand Circular	Right Hand Circular	Right Hand Circular	
Channel Bandwidth (MHz)	36	36	36	
Maximum Power At The Output of Last Stage Amplifier (dBW)	19.8	22.8	19.8	
Loss From Last Stage Amplifier To Transmit Antenna Interface (dB)	3.6	3.8	3.6	
Power Into Transmit Antenna (dBW)	16.2	19.0	16.2	
Power Into Transmit Antenna (Watts)	42.1	79.4	42.1	
Peak Gain of Satellite Transmit Antenna (dBi)	39.3	39.3	39.3	
Maximum Downlink EIRP (dBW)	55.5	58.3	55.5	
Beam Name	Region 1 (High Power Mode)	Region 1 (Low Power Mode)	Region 1 (Low Power Mode)	
Frequency Band (MHz)	10950 – 11200	10950 – 11200	11700 – 11950	
Polarization	Left Hand Circular	Left Hand Circular	Left Hand Circular	
Channel Bandwidth (MHz)	36	36	36	
Maximum Power At The Output of Last Stage Amplifier (dBW)	22.8	19.8	19.8	
Loss From Last Stage Amplifier To Transmit Antenna Interface (dB)	3.8	3.6	3.6	
Power Into Transmit Antenna (dBW)	19.0	16.2	16.2	
Power Into Transmit Antenna (Watts)	79.4	42.1	42.1	
Peak Gain of Satellite Transmit Antenna (dBi)	39.3	39.3	39.3	
Maximum Downlink EIRP (dBW)	58.3	55.5	55.5	

EXHIBIT 6: COMMUNICATION SUBSYSTEM EIRP AND G/T BUDGETS (continued)

Beam Name	Region 2 (Low Power Mode)	Region 2 (High Power Mode)	Region 2 (Low Power Mode)	
Frequency Band (MHz)	10950 – 11200	11700 – 11950	11700 – 11950	
Polarization	Right Hand Circular	Right Hand Circular	Right Hand Circular	
Channel Bandwidth (MHz)	36	36	36	
Maximum Power At The Output of Last Stage Amplifier (dBW)	19.8	22.8	19.8	
Loss From Last Stage Amplifier To Transmit Antenna Interface (dB)	3.5	3.8	3.5	
Power Into Transmit Antenna (dBW)	16.3	19.0	16.3	
Power Into Transmit Antenna (Watts)	42.9	79.4	42.9	
Peak Gain of Satellite Transmit Antenna (dBi)	38.5	38.5	38.5	
Maximum Downlink EIRP (dBW)	54.8	57.5	54.8	
Beam Name	Region 2 (High Power Mode)	Region 2 (Low Power Mode)	Region 2 (Low Power Mode)	
Frequency Band (MHz)	10950 – 11200	10950 – 11200	11700 – 11950	
Polarization	Left Hand Circular	Left Hand Circular	Left Hand Circular	
Channel Bandwidth (MHz)	36	36	36	
Maximum Power At The Output of Last Stage Amplifier (dBW)	22.8	19.8	19.8	
Loss From Last Stage Amplifier To Transmit Antenna Interface (dB)	3.8	3.5	3.5	
Power Into Transmit Antenna (dBW)	19.0	16.3	16.3	
Power Into Transmit Antenna (Watts)	79.4	42.9	42.9	
Peak Gain of Satellite Transmit Antenna (dBi)	38.5	38.5	38.5	
Maximum Downlink EIRP (dBW)	57.5	54.8	54.8	
Beam Name	Region 3 (High Power Mode)	Region 3 (Low Power Mode)	Region 3 (High Power Mode)	Region 3 (Low Power Mode)
Frequency Band (MHz)	10950 – 11200	10950 – 11200	11700 – 11950	11700 – 11950
Polarization	Right Hand Circular	Right Hand Circular	Right Hand Circular	Right Hand Circular
Channel Bandwidth (MHz)	36	36	36	36
Maximum Power At The Output of Last Stage Amplifier (dBW)	24.8	21.8	24.8	21.8
Loss From Last Stage Amplifier To Transmit Antenna Interface (dB)	4.0	3.7	4.0	3.7
Power Into Transmit Antenna (dBW)	20.8	18.1	20.8	18.1
Power Into Transmit Antenna (Watts)	120.2	64.6	120.2	64.6
Peak Gain of Satellite Transmit Antenna (dBi)	37.5	37.5	37.5	37.5
Maximum Downlink EIRP (dBW)	58.3	55.6	58.3	55.6
Beam Name	Region 3 (Low Power Mode)	Region 3 (Low Power Mode)		
Frequency Band (MHz)	10950 – 11200	11700 – 11950		
Polarization	Left Hand Circular	Left Hand Circular		
Channel Bandwidth (MHz)	36	36		
Maximum Power At The Output of Last Stage Amplifier (dBW)	21.8	21.8		
Loss From Last Stage Amplifier To Transmit Antenna Interface (dB)	3.7	3.7		
Power Into Transmit Antenna (dBW)	18.1	18.1		
Power Into Transmit Antenna (Watts)	64.6	64.6		
Peak Gain of Satellite Transmit Antenna (dBi)	37.5	37.5		
Maximum Downlink EIRP (dBW)	55.6	55.6		

EXHIBIT 6: COMMUNICATION SUBSYSTEM EIRP AND G/T BUDGETS (continued)

Beam Name	Region 4 (High Power Mode)	Region 4 (Low Power Mode)	Region 4 (High Power Mode)	Region 4 (Low Power Mode)
Frequency Band (MHz)	10950 – 11200	10950 – 11200	11700 – 11950	11700 – 11950
Polarization	Right Hand Circular	Right Hand Circular	Right Hand Circular	Right Hand Circular
Channel Bandwidth (MHz)	36	36	36	36
Maximum Power At The Output of Last Stage Amplifier (dBW)	24.8	21.8	24.8	21.8
Loss From Last Stage Amplifier To Transmit Antenna Interface (dB)	4.0	3.7	4.0	3.7
Power Into Transmit Antenna (dBW)	20.8	18.1	20.8	18.1
Power Into Transmit Antenna (Watts)	120.3	64.4	120.3	64.4
Peak Gain of Satellite Transmit Antenna (dBi)	36.8	36.8	36.8	36.8
Maximum Downlink EIRP (dBW)	57.6	54.9	57.6	54.9
Beam Name	Region 4 (Low Power Mode)	Region 4 (Low Power Mode)		
Frequency Band (MHz)	10950 – 11200	11700 – 11950		
Polarization	Left Hand Circular	Left Hand Circular		
Channel Bandwidth (MHz)	36	36		
Maximum Power At The Output of Last Stage Amplifier (dBW)	21.8	21.8		
Loss From Last Stage Amplifier To Transmit Antenna Interface (dB)	3.7	3.7		
Power Into Transmit Antenna (dBW)	18.1	18.1		
Power Into Transmit Antenna (Watts)	64.4	64.4		
Peak Gain of Satellite Transmit Antenna (dBi)	36.8	36.8		
Maximum Downlink EIRP (dBW)	54.9	54.9		
Beam Name	ULPC1	ULPC2		
Frequency Band (MHz)	11705.5	11193.0		
Polarization	Left Hand Circular	Right Hand Circular		
Channel Bandwidth (MHz)	0.025	0.025		
Maximum Power At The Output of Last Stage Amplifier (dBW)	-3.0	-3.0		
Loss From Last Stage Amplifier To Transmit Antenna Interface (dB)	3.2	3.2		
Power Into Transmit Antenna (dBW)	-6.2	-6.2		
Power Into Transmit Antenna (Watts)	0.2	0.2		
Peak Gain of Satellite Transmit Antenna (dBi)	24.0	24.0		
Maximum Downlink EIRP (dBW)	17.8	17.8		

EXHIBIT 7: TC&R SUBSYSTEM CHARACTERISTICS

	Global	+Z Pipe	-Z Pipe
Command Frequency (MHz) / Polarization (see note)			
Transfer Orbit / Emergency	n/a	13998.5 (LHCP) 14006.0 (LHCP)	13998.5 (LHCP) 14006.0 (LHCP)
On-Station	13998.5 (H) 14006.0 (H)	n/a	n/a
Command Modulation	FM	FM	FM
Bandwidth of Command Carrier (kHz)			
Occupied Bandwidth	800	800	800
Allocated Bandwidth	1000	1000	1000
Command Threshold (dBW/m^2)			
Beam Peak	-108.4	-94.0	-94.5
Edge of Coverage	-105.8	-93.0	-93.5
Command G/T (dB/K)			
Beam Peak	-18.1	-32.7	-32.2
Edge of Coverage	-20.7	-33.7	-33.2
Telemetry Frequency (MHz) / Polarization (see note)			
Transfer Orbit / Emergency	n/a	11194.25 (RHCP) 11195.5 (RHCP) 11196.25 (RHCP) 11196.75 (RHCP)	11194.25 (RHCP) 11195.5 (RHCP) 11196.25 (RHCP) 11196.75 (RHCP)
On-Station	11194.25 (V) 11195.5 (V) 11196.25 (V) 11196.75 (V)	n/a	n/a
Telemetry Modulation	PM	PM	PM
Bandwidth of Telemetry Carrier (kHz)			
Occupied	300	300	300
Allocated	500	500	500
Telemetry EIRP			
Beam Peak	14.2	15.3	16.1
Edge of Coverage	11.6	14.3	15.1
On-Station Ranging Accuracy (meters)	≤ 30	≤ 30	≤ 30

Note:
H: Linear Horizontal Polarization
V: Linear Vertical Polarization
RHCP: Right Hand Circular Polarization
LHCP: Left Hand Circular Polarization

EXHIBIT 8: TC&R SUBSYSTEM EIRP and G/T BUDGETS

Operating Mode	On-Station	Back-up	Back-up/on-Station
Antenna Type	Global Horn	+Z Pipe	-Z Pipe
Frequency (MHz)	13998.5 / 14006.0	13998.5 / 14006.0	13998.5 / 14006.0
Polarization	Horizontal	Left Hand Circular	Left Hand Circular
Antenna Noise Temperature (°Kelvin)	290	290	290
Receiver Noise Temperature (°Kelvin)	9976	3420	12874
Total System Noise Temperature (°Kelvin)	10266	3710	13164
Total System Noise Temperature (dB/K)	40.1	35.7	41.2
Peak Gain of Satellite Receive Antenna (dBi)	22.0	3.0	9.0
Peak G/T (dB/K)	-18.1	-32.7	-32.2
SFD Threshold at Peak G/T (dBW/m^2)	-108.4	-94.0	-94.5
Operating Mode	On-Station	Back-up	Back-up
Antenna Type	Global	Omni (+Z)	Omni (-Z)
Frequency (MHz)	11194.25 11195.5 11196.25 11196.75	11194.25 11195.5 11196.25 11196.75	11194.25 11195.5 11196.25 11196.75
Polarization	Vertical	Right Hand Circular	Right Hand Circular
Maximum Power At The Output of Last Stage Amplifier (dBW)	-3.0	15.4	15.4
Loss From Last Stage Amplifier To Transmit Antenna Interface (dB)	4.8	3.1	8.3
Power Into The Transmit Antenna (dBW)	-7.8	12.3	7.1
Power Into The Transmit Antenna (Watts)	0.2	16.9	5.2
Peak Gain of Satellite Transmit Antenna (dBi)	22.0	3.0	9.0
Maximum Downlink EIRP (dBW)	14.2	15.3	16.1

EXHIBIT 9: EMISSION DESIGNATORS

Signal Type	Emission Designator	Allocated Bandwidth (kHz)
Analog TV/FM Carrier	30M0F3F	30000
64 kbps Carrier	100KG7W	100
6000 kbps carrier	10M3G7W	10300
5461 kbps carrier	8M00G7W	8000
16383 kbps carrier	24M0G7W	24000
24575 kbps carrier	36M0G7W	36000
47511 kbps Carrier	69M6G7W	69600

EXHIBIT 10: POWER FLUX DENSITY CALCULATIONS

FREQUENCY BAND : 3400 - 3700 MHz							
Global Beam (H) - 36M0F3F							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	37.0	37.0	37.0	37.0	37.0	37.0	37.0
Carrier Occupied Bandwidth (kHz)	4000.0	4000.0	4000.0	4000.0	4000.0	4000.0	4000.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-156.4	-156.3	-156.2	-156.0	-155.9	-155.8	-155.1
FCC Limit (dBW/m^2/4Hz)	-152.0	-152.0	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	4.4	4.3	6.7	9.0	11.4	13.8	13.1
Global Beam (H) - 69M6G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	37.0	37.0	37.0	37.0	37.0	37.0	37.0
Carrier Occupied Bandwidth (kHz)	58257.1	58257.1	58257.1	58257.1	58257.1	58257.1	58257.1
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-168.0	-167.9	-167.8	-167.7	-167.6	-167.5	-166.7
FCC Limit (dBW/m^2/4Hz)	-152.0	-152.0	-149.5	-147.0	-144.5	-142.0	-142.0
Margin (dB)	16.0	15.9	18.3	20.7	23.1	25.5	24.7

EXHIBIT 10: POWER FLUX DENSITY CALCULATIONS (continued)

FREQUENCY BAND : 10950 - 11200 MHz and 11450 - 11700							
Pan Regional Beam (LHCP) - 24M0G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	50.4*	50.3*	52.7*	55.1*	57.4*	57.8	57.8
Carrier Occupied Bandwidth (kHz)	20089.0	20089.0	20089.0	20089.0	20089.0	20089.0	20089.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-150.0	-150.0	-147.5	-145.0	-142.5	-142.0	-141.3
FCC Limit (dBW/m^2/4Hz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.0	0.0	0.0	2.0	1.3
Pan Regional Beam (RHCP) - 24M0G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	50.4*	50.3*	52.7*	55.1*	57.4*	59.8*	59.1*
Carrier Occupied Bandwidth (kHz)	20089.0	20089.0	20089.0	20089.0	20089.0	20089.0	20089.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
FCC Limit (dBW/m^2/4Hz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.0	0.0	0.0	0.0	0.0

EXHIBIT 10: POWER FLUX DENSITY CALCULATIONS (continued)

FREQUENCY BAND : 10950 - 11200 MHz and 11450 - 11700							
Region 1 Beam (RHCP) - 36M0G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	52.2*	52.0*	54.4*	55.5	55.5	55.5	55.5
Carrier Occupied Bandwidth (kHz)	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density ($dBW/m^2/4kHz$)	-150.0	-150.0	-147.5	-146.3	-146.2	-146.1	-145.3
FCC Limit ($dBW/m^2/4Hz$)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.0	1.3	3.7	6.1	5.3
Region 1 Beam (LHCP) - 36M0G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	52.2*	52.0*	54.4*	56.8*	58.3	58.3	58.3
Carrier Occupied Bandwidth (kHz)	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density ($dBW/m^2/4kHz$)	-150.0	-150.0	-147.5	-145.0	-143.4	-143.3	-142.5
FCC Limit ($dBW/m^2/4Hz$)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.0	0.0	0.9	3.3	2.5

EXHIBIT 10: POWER FLUX DENSITY CALCULATIONS (continued)

FREQUENCY BAND : 10950 – 11200 MHz and 11450 – 11700 MHz							
Region 2 Beam (LHCP) - 36M0G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	52.2*	52.0*	54.4*	56.8*	57.5	57.5	57.5
Carrier Occupied Bandwidth (kHz)	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-150.0	-150.0	-147.5	-145.0	-144.2	-144.1	-143.3
FCC Limit (dBW/m^2/4Hz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.0	0.0	1.7	4.1	3.3
Region 2 Beam (RHCP) - 36M0G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	52.2*	52.0*	54.4*	54.8	54.8	54.8	54.8
Carrier Occupied Bandwidth (kHz)	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-150.0	-150.0	-147.5	-147.0	-146.9	-146.8	-146.0
FCC Limit (dBW/m^2/4Hz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.0	2.0	4.4	6.8	6.0

EXHIBIT 10: POWER FLUX DENSITY CALCULATIONS (continued)

FREQUENCY BAND : 10950 – 11200 MHz and 11450 – 11700 MHz							
Region 3 Beam (LHCP) - 36M0G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	52.2*	52.0*	54.4*	55.6	55.6	55.6	55.6
Carrier Occupied Bandwidth (kHz)	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density ($dBW/m^2/4kHz$)	-150.0	-150.0	-147.5	-146.2	-146.1	-146.0	-145.2
FCC Limit ($dBW/m^2/4Hz$)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.0	1.2	3.6	6.0	5.2
Region 3 Beam (RHCP) - 36M0G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	52.2*	52.0*	54.4*	56.8*	58.3	58.3	58.3
Carrier Occupied Bandwidth (kHz)	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density ($dBW/m^2/4kHz$)	-150.0	-150.0	-147.5	-145.0	-143.4	-143.3	-142.5
FCC Limit ($dBW/m^2/4Hz$)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.0	0.0	0.9	3.3	2.5

EXHIBIT 10: POWER FLUX DENSITY CALCULATIONS (continued)

FREQUENCY BAND : 10950 – 11200 MHz and 11450 – 11700 MHz							
Region 4 Beam (RHCP) - 36M0G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	52.2*	52.0*	54.4*	56.8*	57.6	57.6	57.6
Carrier Occupied Bandwidth (kHz)	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-150.0	-150.0	-147.5	-145.0	-144.1	-144.0	-143.2
FCC Limit (dBW/m^2/4Hz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.0	0.0	1.6	4.0	3.2
Region 4 Beam (LHCP) - 36M0G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	52.2*	52.0*	54.4*	54.9	54.9	54.9	54.9
Carrier Occupied Bandwidth (kHz)	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0	30133.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-150.0	-150.0	-147.5	-146.9	-146.8	-146.7	-145.9
FCC Limit (dBW/m^2/4Hz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.0	1.9	4.3	6.7	5.9

EXHIBIT 10: POWER FLUX DENSITY CALCULATIONS (continued)

FREQUENCY BAND : 10950 – 11200 MHz and 11450 – 11700 MHz							
TCN - Pan Regional Beam (RHCP) - 36M0G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	45.6*	45.5*	47.9*	50.3*	52.7*	54.3	54.3
Carrier Occupied Bandwidth (kHz)	6696.0	6696.0	6696.0	6696.0	6696.0	6696.0	6696.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.8	-140.0
FCC Limit (dBW/m^2/4Hz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.0	0.0	0.0	0.8	0.0
TCN - CBC Beam (RHCP) - 36M0G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	45.6*	45.5*	47.2	47.2	47.2	47.2	47.2
Carrier Occupied Bandwidth (kHz)	6696.0	6696.0	6696.0	6696.0	6696.0	6696.0	6696.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-150.0	-150.0	-148.2	-148.1	-148.0	-147.9	-147.1
FCC Limit (dBW/m^2/4Hz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	0.0	0.0	0.7	3.1	5.5	7.9	7.1

EXHIBIT 10: POWER FLUX DENSITY CALCULATIONS (continued)

FREQUENCY BAND : 10950 – 11200 MHz and 11450 – 11700 MHz							
ULPC Beam (RHCP) - 25K0G7W							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	17.8	17.8	17.8	17.8	17.8	17.8	17.8
Carrier Occupied Bandwidth (kHz)	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density ($dBW/m^2/4kHz$)	-153.5	-153.4	-153.3	-153.2	-153.1	-153.0	-152.2
FCC Limit ($dBW/m^2/4Hz$)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	3.5	3.4	5.8	8.2	10.6	13.0	12.2
Telemetry (V) - 300KG7W [Global Horn Antenna]							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	14.2	14.2	14.2	14.2	14.2	14.2	14.2
Carrier Occupied Bandwidth (kHz)	300.0	300.0	300.0	300.0	300.0	300.0	300.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density ($dBW/m^2/4kHz$)	-167.9	-167.8	-167.7	-167.6	-167.5	-167.4	-166.6
FCC Limit ($dBW/m^2/4Hz$)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	17.9	17.8	20.2	22.6	25.0	27.4	26.6

EXHIBIT 10: POWER FLUX DENSITY CALCULATIONS (continued)

FREQUENCY BAND : 10950 – 11200 MHz and 11450 – 11700 MHz							
Telemetry (RHCP) - 300KG7W [+Z Antenna]							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	15.3	15.3	15.3	15.3	15.3	15.3	15.3
Carrier Occupied Bandwidth (kHz)	300.0	300.0	300.0	300.0	300.0	300.0	300.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-166.8	-166.7	-166.6	-166.5	-166.4	-166.3	-165.5
FCC Limit (dBW/m^2/4Hz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	16.8	16.7	19.1	21.5	23.9	26.3	25.5
Telemetry (LHCP) - 300KG7W [-Z Antenna]							
Elevation Angle (degrees)	0.0	5.0	10.0	15.0	20.0	25.0	90.0
Assumed EIRP	16.1	16.1	16.1	16.1	16.1	16.1	16.1
Carrier Occupied Bandwidth (kHz)	300.0	300.0	300.0	300.0	300.0	300.0	300.0
Spreading Loss (dB/m^2)	163.4	163.3	163.2	163.0	162.9	162.8	162.1
Maximum EIRP Spectral Density (dBW/m^2/4kHz)	-166.0	-165.9	-165.8	-165.7	-165.6	-165.5	-164.7
FCC Limit (dBW/m^2/4Hz)	-150.0	-150.0	-147.5	-145.0	-142.5	-140.0	-140.0
Margin (dB)	16.0	15.9	18.3	20.7	23.1	25.5	24.7

* This is the maximum allowable EIRP level at the specified elevation angle. The actual EIRP level of the carrier at this particular elevation angle will be made to be equal to or lower than the value listed in the table through reduction in the output power of the channel and/or restriction on the movement/placement of the beam.

EXHIBIT 11: RECEIVE AND TRANSMIT SECTION FILTER RESPONSE CHARACTERISTICS

	Attenuation Relative To Peak Level (dB)		
Frequency Offset Relative to Channel Center Frequency (MHz)	Input Section	Output Section	Total
C-Band: 69.6 MHz Channel			
±15.5	0.31	0.38	0.61
±23.2	0.37	0.47	0.72
±27.1	0.40	0.57	0.82
±30.9	0.47	0.66	0.97
±34.8	0.65	1.31	1.78
Ku-Band: 8 MHz Channel			
±2.0	0.29	0.67	0.90
±2.5	0.36	0.91	1.19
±3.0	0.53	1.09	1.53
±3.5	0.96	1.42	2.27
±4.0	1.78	2.05	3.70
Ku-Band: 24 MHz Channel			
±5.5	0.36	0.34	0.60
±8.0	0.44	0.55	0.85
±9.5	0.62	0.86	1.31
±10.5	0.80	1.11	1.73
±12.0	1.09	2.16	3.05
Ku-Band: 36 MHz Channel			
±8.0	0.41	0.31	0.39
±12.0	0.55	0.56	0.56
±14.0	0.74	0.75	0.80
±16.0	1.29	1.24	0.99
±18.0	2.44	2.93	2.17

EXHIBIT 12: INTELSAT 31 LINK BUDGETS

UPLINK BEAM INFORMATION				
Uplink Beam Name	Global	Global	Global	Global
Uplink Frequency (GHz)	6.575	6.575	6.575	6.575
Uplink Beam Polarization	Linear	Linear	Linear	Linear
Uplink Relative Contour Level (dB)	-7.0	-7.0	-7.0	-7.0
Uplink Contour G/T (dB/K)	-14.8	-14.8	-14.8	-14.8
Uplink SFD (dBW/m2)	-72	-83	-79	-79
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
DOWNLINK BEAM INFORMATION				
Downlink Beam Name	Global	Global	Global	Global
Downlink Frequency (GHz)	3.550	3.550	3.550	3.550
Downlink Beam Polarization	Linear	Linear	Linear	Linear
Downlink Relative Contour Level (dB)	-7.0	-7.0	-7.0	-7.0
Downlink Contour EIRP (dBW)	30.0	30.0	30.0	30.0
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
ADJACENT SATELLITE 1				
Satellite 1 Orbital Location	93.05W	93.05W	93.05W	93.05W
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-39.0	-39.0	-39.0	-39.0
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
ADJACENT SATELLITE 2				
Satellite 1 Orbital Location	97.05W	97.05W	97.05W	97.05W
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-39.0	-39.0	-39.0	-39.0
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
CARRIER INFORMATION				
Carrier ID	30M0F3F	69M6G7W	10M3G7W	100KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A
Information Rate(kbps)	N/A	47511	6000	64
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256
Occupied Bandwidth(kHz)	30000	58257	6771.1	75.4
Allocated Bandwidth(kHz)	30000	69600	10300	100
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79
UPLINK EARTH STATION				
Earth Station Diameter (meters)	15.2	11.0	6.1	6.1
Earth Station Gain (dBi)	58.9	55.9	49.9	49.9
Earth Station Elevation Angle	20	20	20	20
DOWNLINK EARTH STATION				
Earth Station Diameter (meters)	11.0	4.5	6.1	6.1
Earth Station Gain (dBi)	51.0	43.0	45.6	45.6
Earth Station G/T (dB/K)	30.1	22.7	25.3	25.3
Earth Station Elevation Angle	20	20	20	20
LINK FADE TYPE	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE				
Uplink Earth Station EIRP (dBW)	82.7	79.9	68.8	48.4
Uplink Path Loss, Clear Sky (dB)	-200.8	-200.8	-200.8	-200.8
Uplink Rain Attenuation	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	-14.8	-14.8	-14.8	-14.8
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-74.8	-77.7	-68.3	-48.8
Uplink C/N(dB)	21.0	15.3	13.6	12.7
DOWNLINK PERFORMANCE				
Downlink EIRP per Carrier (dBW)	26.5	30.0	19.6	-.8
Antenna Pointing Error (dB)	-.5	-.5	-.5	-.5
Downlink Path Loss, Clear Sky (dB)	-195.4	-195.4	-195.4	-195.4
Downlink Rain Attenuation	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	30.1	22.7	25.3	25.3
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-74.8	-77.7	-68.3	-48.8
Downlink C / N(dB)	14.5	7.7	9.3	8.4
COMPOSITE LINK PERFORMANCE				
C/N Uplink (dB)	21.0	15.3	13.6	12.7
C/N Downlink (dB)	14.5	7.7	9.3	8.4
C/I Intermodulation (dB)	N/A	N/A	19.9	19.0
C/I Uplink Co-Channel (dB)*	30.7	27.0	28.4	28.1
C/I Downlink Co-Channel (dB)*	30.7	27.0	28.4	28.1
C/I Uplink Adjacent Satellite 1 (dB)	21.6	15.9	14.2	13.3
C/I Downlink Adjacent Satellite 1 (dB)	19.6	11.3	13.3	12.4
C/I Uplink Adjacent Satellite 2 (dB)	21.6	15.9	14.2	13.3
C/I Downlink Adjacent Satellite 2 (dB)	20.7	14.1	15.4	14.5
C/(N+I) Composite (dB)	11.1	4.4	4.9	4.0
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	10.1	3.4	3.9	3.0
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0
Excess Link Margin (dB)	.1	0.0	0.0	0.0
Number of Carriers	1.0	1.0	4.9	534.4
CARRIER DENSITY LEVELS				
Uplink Power Density (dBW/Hz)	-42.3	-53.7	-49.4	-50.3
Downlink EIRP Density At Beam Peak (dBW/Hz)	-32.5	-40.7	-41.7	-42.6

EXHIBIT 12: INTELSAT 31 LINK BUDGETS (continued)

UPLINK BEAM INFORMATION					
Uplink Beam Name	Composite	Composite	Composite	TCN	TCN
Uplink Frequency (GHz)	14.125	14.125	14.125	14.495	14.495
Uplink Beam Polarization	Linear	Linear	Linear	Linear	Linear
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-2.6	-2.6
Uplink Contour G/T (dB/K)	9.3	9.3	9.3	-7.4	-7.4
Uplink SFD (dBW/m2)	-77.3	-77.3	-77.3	-78	-78.0
Rain Rate (mm/hr)	95.0	95.0	95.0	95.0	95.0
DOWNLINK BEAM INFORMATION					
Downlink Beam Name	Composite	Pan Regional	Pan Regional	CBC	Pan Regional
Downlink Frequency (GHz)	11.575	11.575	11.575	11.460	11.460
Downlink Beam Polarization	Circular	Circular	Circular	Circular	Circular
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	48.8	51.8	51.8	41.2	48.3
Rain Rate (mm/hr)	95.0	95.0	95.0	42.0	95.0
ADJACENT SATELLITE 1					
Satellite 1 Orbital Location	93.05W	93.05W	93.05W	93.05W	93.05W
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-16.5	-19.8	-21.2	-27.0	-20.0
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0
ADJACENT SATELLITE 2					
Satellite 1 Orbital Location	97.05W	97.05W	97.05W	97.05W	97.05W
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-16.5	-19.8	-21.2	-27.0	-20.0
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0
CARRIER INFORMATION					
Carrier ID	36M0G7W	24M0G7W	24M0G7W	8M00G7W	8M00G7W
Carrier Modulation	QPSK	QPSK	QPSK	QPSK	QPSK
Peak to Peak Bandwidth of EDS (MHz)	N/A	N/A	N/A	N/A	N/A
Information Rate(kbps)	24575	16383	16383	5461	5461
Code Rate	1/2x188/204	1/2x188/204	1/2x188/204	1/2x188/204	1/2x188/204
Occupied Bandwidth(kHz)	30133	20089	20089	6696	6696
Allocated Bandwidth(kHz)	36000	24000	24000	8000	8000
Minimum C/N, Clear Sky (dB)	3.36	3.36	3.36	3.36	3.36
Minimum C/N, Rain (dB)	3.36	3.36	3.36	3.36	3.36
UPLINK EARTH STATION					
Earth Station Diameter (meters)	6.1	6.1	6.1	6.1	6.1
Earth Station Gain (dBi)	56.8	56.8	56.8	57.0	57.0
Earth Station Elevation Angle	20	20	20	20	20
DOWNLINK EARTH STATION					
Earth Station Diameter (meters)	3.7	3.0	2.4	1.8	2.4
Earth Station Gain (dBi)	50.8	48.9	47.2	44.4	47.1
Earth Station G/T (dB/K)	28.3	26.4	24.7	21.9	24.6
Earth Station Elevation Angle	20	20	20	20	20
LINK FADE TYPE	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE					
Uplink Earth Station EIRP (dBW)	73.7	69.0	69.0	74.1	67.0
Uplink Path Loss, Clear Sky (dB)	-207.4	-207.4	-207.4	-207.6	-207.6
Uplink Rain Attenuation	0.0	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	9.3	9.3	9.3	-7.4	-7.4
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-74.8	-73.0	-73.0	-68.3	-68.3
Uplink C/N(dB)	29.4	26.5	26.5	19.4	12.3
DOWNLINK PERFORMANCE					
Downlink EIRP per Carrier (dBW)	42.8	41.0	41.0	36.3	36.2
Antenna Pointing Error (dB)	-.5	-.5	-.5	-.5	-.5
Downlink Path Loss, Clear Sky (dB)	-205.7	-205.7	-205.7	-205.6	-205.6
Downlink Rain Attenuation	0.0	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	28.3	26.4	24.7	21.9	24.6
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-74.8	-73.0	-73.0	-68.3	-68.3
Downlink C / N(dB)	18.7	16.8	15.1	12.5	15.1
COMPOSITE LINK PERFORMANCE					
C/N Uplink (dB)	29.4	26.5	26.5	19.4	12.3
C/N Downlink (dB)	18.7	16.8	15.1	12.5	15.1
C/I Intermodulation (dB)	N/A	N/A	N/A	N/A	N/A
C/I Uplink Co-Channel (dB)*	27.0	27.0	27.0	27.0	27.0
C/I Downlink Co-Channel (dB)*	27.0	27.0	27.0	27.0	27.0
C/I Uplink Adjacent Satellite 1 (dB)	19.9	17.0	17.0	30.2	23.1
C/I Downlink Adjacent Satellite 1 (dB)	13.3	14.6	14.1	16.8	12.8
C/I Uplink Adjacent Satellite 2 (dB)	19.3	16.4	16.4	29.7	22.6
C/I Downlink Adjacent Satellite 2 (dB)	13.8	15.3	15.1	18.5	13.8
C/(N+I) Composite (dB)	8.9	8.7	8.3	9.6	7.0
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	7.9	7.7	7.3	8.6	6.0
Minimum Required C/N (dB)	-3.4	-3.4	-3.4	-3.4	-3.4
Excess Link Margin (dB)	4.5	4.4	3.9	5.3	2.7
Number of Carriers	1.0	1.0	1.0	1.0	1.0
CARRIER DENSITY LEVELS					
Uplink Power Density (dBW/Hz)	-57.9	-60.9	-60.9	-51.2	-58.3
Downlink EIRP Density At Beam Peak (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0

EXHIBIT 13: ADJACENT SATELLITE (93.05º W.L) LINK BUDGETS

UPLINK BEAM INFORMATION				
Uplink Beam Name	Global	Global	Global	Global
Uplink Frequency (GHz)	6.575	6.575	6.575	6.575
Uplink Beam Polarization	Linear	Linear	Linear	Linear
Uplink Relative Contour Level (dB)	-7.0	-7.0	-7.0	-7.0
Uplink Contour G/T (dB/K)	-14.8	-14.8	-14.8	-14.8
Uplink SFD (dBW/m2)	-72	-83	-79	-79
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
DOWNLINK BEAM INFORMATION				
Downlink Beam Name	Global	Global	Global	Global
Downlink Frequency (GHz)	3.550	3.550	3.550	3.550
Downlink Beam Polarization	Linear	Linear	Linear	Linear
Downlink Relative Contour Level (dB)	-7.0	-7.0	-7.0	-7.0
Downlink Contour EIRP (dBW)	30.0	30.0	30.0	30.0
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
ADJACENT SATELLITE 1				
Satellite 1 Orbital Location	95.05W	95.05W	95.05W	95.05W
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-39.0	-39.0	-39.0	-39.0
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
ADJACENT SATELLITE 2				
Satellite 1 Orbital Location	91.05W	91.05W	91.05W	91.05W
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-39.0	-39.0	-39.0	-39.0
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
CARRIER INFORMATION				
Carrier ID	30M0F3F	69M6G7W	10M3G7W	100KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A
Information Rate(kbps)	N/A	47511	6000	64
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256
Occupied Bandwidth(kHz)	30000	58257	6771.1	75.4
Allocated Bandwidth(kHz)	30000	69600	10300	100
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79
UPLINK EARTH STATION				
Earth Station Diameter (meters)	15.2	11.0	6.1	6.1
Earth Station Gain (dBi)	58.9	55.9	49.9	49.9
Earth Station Elevation Angle	20	20	20	20
DOWNLINK EARTH STATION				
Earth Station Diameter (meters)	11.0	4.5	6.1	6.1
Earth Station Gain (dBi)	51.0	43.0	45.6	45.6
Earth Station G/T (dB/K)	30.1	22.7	25.3	25.3
Earth Station Elevation Angle	20	20	20	20
LINK FADE TYPE	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE				
Uplink Earth Station EIRP (dBW)	82.7	79.9	68.8	48.4
Uplink Path Loss, Clear Sky (dB)	-200.8	-200.8	-200.8	-200.8
Uplink Rain Attenuation	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	-14.8	-14.8	-14.8	-14.8
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-74.8	-77.7	-68.3	-48.8
Uplink C/N(dB)	21.0	15.3	13.6	12.7
DOWNLINK PERFORMANCE				
Downlink EIRP per Carrier (dBW)	26.5	30.0	19.6	-.8
Antenna Pointing Error (dB)	-.5	-.5	-.5	-.5
Downlink Path Loss, Clear Sky (dB)	-195.4	-195.4	-195.4	-195.4
Downlink Rain Attenuation	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	30.1	22.7	25.3	25.3
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-74.8	-77.7	-68.3	-48.8
Downlink C / N(dB)	14.5	7.7	9.3	8.4
COMPOSITE LINK PERFORMANCE				
C/N Uplink (dB)	21.0	15.3	13.6	12.7
C/N Downlink (dB)	14.5	7.7	9.3	8.4
C/I Intermodulation (dB)	N/A	N/A	19.9	19.0
C/I Uplink Co-Channel (dB)*	30.7	27.0	28.4	28.1
C/I Downlink Co-Channel (dB)*	30.7	27.0	28.4	28.1
C/I Uplink Adjacent Satellite 1 (dB)	21.6	15.9	14.2	13.3
C/I Downlink Adjacent Satellite 1 (dB)	19.6	11.3	13.3	12.4
C/I Uplink Adjacent Satellite 2 (dB)	21.6	15.9	14.2	13.3
C/I Downlink Adjacent Satellite 2 (dB)	20.7	14.1	15.4	14.5
C/(N+I) Composite (dB)	11.1	4.4	4.9	4.0
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	10.1	3.4	3.9	3.0
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0
Excess Link Margin (dB)	.1	0.0	0.0	0.0
Number of Carriers	1.0	1.0	4.9	534.4
CARRIER DENSITY LEVELS				
Uplink Power Density (dBW/Hz)	-42.3	-53.7	-49.4	-50.3
Downlink EIRP Density At Beam Peak (dBW/Hz)	-32.5	-40.7	-41.7	-42.6

EXHIBIT 13: ADJACENT SATELLITE (93.05º W.L) LINK BUDGETS (continued)

UPLINK BEAM INFORMATION					
Uplink Beam Name	Composite	Composite	Composite	TCN	TCN
Uplink Frequency (GHz)	14.125	14.125	14.125	14.495	14.495
Uplink Beam Polarization	Linear	Linear	Linear	Linear	Linear
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-2.6	-2.6
Uplink Contour G/T (dB/K)	9.3	9.3	9.3	-7.4	-7.4
Uplink SFD (dBW/m2)	-77.3	-77.3	-77.3	-78	-78.0
Rain Rate (mm/hr)	95.0	95.0	95.0	95.0	95.0
DOWNLINK BEAM INFORMATION					
Downlink Beam Name	Composite	Pan Regional	Pan Regional	CBC	Pan Regional
Downlink Frequency (GHz)	11.575	11.575	11.575	11.460	11.460
Downlink Beam Polarization	Circular	Circular	Circular	Circular	Circular
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	48.8	51.8	51.8	41.2	48.3
Rain Rate (mm/hr)	95.0	95.0	95.0	42.0	95.0
ADJACENT SATELLITE 1					
Satellite 1 Orbital Location	95.05W	95.05W	95.05W	95.05W	95.05W
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-16.5	-19.8	-21.2	-27.0	-20.0
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0
ADJACENT SATELLITE 2					
Satellite 1 Orbital Location	91.05W	91.05W	91.05W	91.05W	91.05W
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-16.5	-19.8	-21.2	-27.0	-20.0
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0
CARRIER INFORMATION					
Carrier ID	36M0G7W	24M0G7W	24M0G7W	8M00G7W	8M00G7W
Carrier Modulation	QPSK	QPSK	QPSK	QPSK	QPSK
Peak to Peak Bandwidth of EDS (MHz)	N/A	N/A	N/A	N/A	N/A
Information Rate(kbps)	24575	16383	16383	5461	5461
Code Rate	1/2x188/204	1/2x188/204	1/2x188/204	1/2x188/204	1/2x188/204
Occupied Bandwidth(kHz)	30133	20089	20089	6696	6696
Allocated Bandwidth(kHz)	36000	24000	24000	8000	8000
Minimum C/N, Clear Sky (dB)	3.36	3.36	3.36	3.36	3.36
Minimum C/N, Rain (dB)	3.36	3.36	3.36	3.36	3.36
UPLINK EARTH STATION					
Earth Station Diameter (meters)	6.1	6.1	6.1	6.1	6.1
Earth Station Gain (dBi)	56.8	56.8	56.8	57.0	57.0
Earth Station Elevation Angle	20	20	20	20	20
DOWNLINK EARTH STATION					
Earth Station Diameter (meters)	3.7	3.0	2.4	1.8	2.4
Earth Station Gain (dBi)	50.8	48.9	47.2	44.4	47.1
Earth Station G/T (dB/K)	28.3	26.4	24.7	21.9	24.6
Earth Station Elevation Angle	20	20	20	20	20
LINK FADE TYPE	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE					
Uplink Earth Station EIRP (dBW)	73.7	69.0	69.0	74.1	67.0
Uplink Path Loss, Clear Sky (dB)	-207.4	-207.4	-207.4	-207.6	-207.6
Uplink Rain Attenuation	0.0	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	9.3	9.3	9.3	-7.4	-7.4
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-74.8	-73.0	-73.0	-68.3	-68.3
Uplink C/N(dB)	29.4	26.5	26.5	19.4	12.3
DOWNLINK PERFORMANCE					
Downlink EIRP per Carrier (dBW)	42.8	41.0	41.0	36.3	36.2
Antenna Pointing Error (dB)	-.5	-.5	-.5	-.5	-.5
Downlink Path Loss, Clear Sky (dB)	-205.7	-205.7	-205.7	-205.6	-205.6
Downlink Rain Attenuation	0.0	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	28.3	26.4	24.7	21.9	24.6
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-74.8	-73.0	-73.0	-68.3	-68.3
Downlink C / N(dB)	18.7	16.8	15.1	12.5	15.1
COMPOSITE LINK PERFORMANCE					
C/N Uplink (dB)	29.4	26.5	26.5	19.4	12.3
C/N Downlink (dB)	18.7	16.8	15.1	12.5	15.1
C/I Intermodulation (dB)	N/A	N/A	N/A	N/A	N/A
C/I Uplink Co-Channel (dB)*	27.0	27.0	27.0	27.0	27.0
C/I Downlink Co-Channel (dB)*	27.0	27.0	27.0	27.0	27.0
C/I Uplink Adjacent Satellite 1 (dB)	19.9	17.0	17.0	30.2	23.1
C/I Downlink Adjacent Satellite 1 (dB)	13.3	14.6	14.1	16.8	12.8
C/I Uplink Adjacent Satellite 2 (dB)	19.3	16.4	16.4	29.7	22.6
C/I Downlink Adjacent Satellite 2 (dB)	13.8	15.3	15.1	18.5	13.8
C/(N+I) Composite (dB)	8.9	8.7	8.3	9.6	7.0
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	7.9	7.7	7.3	8.6	6.0
Minimum Required C/N (dB)	-3.4	-3.4	-3.4	-3.4	-3.4
Excess Link Margin (dB)	4.5	4.4	3.9	5.3	2.7
Number of Carriers	1.0	1.0	1.0	1.0	1.0
CARRIER DENSITY LEVELS					
Uplink Power Density (dBW/Hz)	-57.9	-60.9	-60.9	-51.2	-58.3
Downlink EIRP Density At Beam Peak (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0

EXHIBIT 14: ADJACENT SATELLITE (97.05º W.L.) LINK BUDGETS

UPLINK BEAM INFORMATION				
Uplink Beam Name	Global	Global	Global	Global
Uplink Frequency (GHz)	6.575	6.575	6.575	6.575
Uplink Beam Polarization	Linear	Linear	Linear	Linear
Uplink Relative Contour Level (dB)	-7.0	-7.0	-7.0	-7.0
Uplink Contour G/T (dB/K)	-14.8	-14.8	-14.8	-14.8
Uplink SFD (dBW/m2)	-72	-83	-79	-79
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
DOWNLINK BEAM INFORMATION				
Downlink Beam Name	Global	Global	Global	Global
Downlink Frequency (GHz)	3.550	3.550	3.550	3.550
Downlink Beam Polarization	Linear	Linear	Linear	Linear
Downlink Relative Contour Level (dB)	-7.0	-7.0	-7.0	-7.0
Downlink Contour EIRP (dBW)	30.0	30.0	30.0	30.0
Rain Rate (mm/hr)	42.0	42.0	42.0	42.0
ADJACENT SATELLITE 1				
Satellite 1 Orbital Location	99.05W	99.05W	99.05W	99.05W
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-39.0	-39.0	-39.0	-39.0
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
ADJACENT SATELLITE 2				
Satellite 1 Orbital Location	95.05W	95.05W	95.05W	95.05W
Uplink Power Density (dBW/Hz)	-38.7	-38.7	-38.7	-38.7
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-39.0	-39.0	-39.0	-39.0
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0
CARRIER INFORMATION				
Carrier ID	30M0F3F	69M6G7W	10M3G7W	100KG7W
Carrier Modulation	TV/FM	QPSK	QPSK	QPSK
Peak to Peak Bandwidth of EDS (MHz)	4	N/A	N/A	N/A
Information Rate(kbps)	N/A	47511	6000	64
Code Rate	N/A	1/2x188/204	1/2x188/204	1/2x239/256
Occupied Bandwidth(kHz)	30000	58257	6771.1	75.4
Allocated Bandwidth(kHz)	30000	69600	10300	100
Minimum C/N, Clear Sky (dB)	10.0	3.36	3.87	2.99
Minimum C/N, Rain (dB)	10.0	3.36	3.57	2.79
UPLINK EARTH STATION				
Earth Station Diameter (meters)	15.2	11.0	6.1	6.1
Earth Station Gain (dBi)	58.9	55.9	49.9	49.9
Earth Station Elevation Angle	20	20	20	20
DOWNLINK EARTH STATION				
Earth Station Diameter (meters)	11.0	4.5	6.1	6.1
Earth Station Gain (dBi)	51.0	43.0	45.6	45.6
Earth Station G/T (dB/K)	30.1	22.7	25.3	25.3
Earth Station Elevation Angle	20	20	20	20
LINK FADE TYPE	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE				
Uplink Earth Station EIRP (dBW)	82.7	79.9	68.8	48.4
Uplink Path Loss, Clear Sky (dB)	-200.8	-200.8	-200.8	-200.8
Uplink Rain Attenuation	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	-14.8	-14.8	-14.8	-14.8
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-74.8	-77.7	-68.3	-48.8
Uplink C/N(dB)	21.0	15.3	13.6	12.7
DOWNLINK PERFORMANCE				
Downlink EIRP per Carrier (dBW)	26.5	30.0	19.6	-.8
Antenna Pointing Error (dB)	-.5	-.5	-.5	-.5
Downlink Path Loss, Clear Sky (dB)	-195.4	-195.4	-195.4	-195.4
Downlink Rain Attenuation	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	30.1	22.7	25.3	25.3
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-74.8	-77.7	-68.3	-48.8
Downlink C / N(dB)	14.5	7.7	9.3	8.4
COMPOSITE LINK PERFORMANCE				
C/N Uplink (dB)	21.0	15.3	13.6	12.7
C/N Downlink (dB)	14.5	7.7	9.3	8.4
C/I Intermodulation (dB)	N/A	N/A	19.9	19.0
C/I Uplink Co-Channel (dB)*	30.7	27.0	28.4	28.1
C/I Downlink Co-Channel (dB)*	30.7	27.0	28.4	28.1
C/I Uplink Adjacent Satellite 1 (dB)	21.6	15.9	14.2	13.3
C/I Downlink Adjacent Satellite 1 (dB)	19.6	11.3	13.3	12.4
C/I Uplink Adjacent Satellite 2 (dB)	21.6	15.9	14.2	13.3
C/I Downlink Adjacent Satellite 2 (dB)	20.7	14.1	15.4	14.5
C/(N+I) Composite (dB)	11.1	4.4	4.9	4.0
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	10.1	3.4	3.9	3.0
Minimum Required C/N (dB)	-10.0	-3.4	-3.9	-3.0
Excess Link Margin (dB)	.1	0.0	0.0	0.0
Number of Carriers	1.0	1.0	4.9	534.4
CARRIER DENSITY LEVELS				
Uplink Power Density (dBW/Hz)	-42.3	-53.7	-49.4	-50.3
Downlink EIRP Density At Beam Peak (dBW/Hz)	-32.5	-40.7	-41.7	-42.6

EXHIBIT 14: ADJACENT SATELLITE (97.05º W.L.) LINK BUDGETS (continued)

UPLINK BEAM INFORMATION					
Uplink Beam Name	Composite	Composite	Composite	TCN	TCN
Uplink Frequency (GHz)	14.125	14.125	14.125	14.495	14.495
Uplink Beam Polarization	Linear	Linear	Linear	Linear	Linear
Uplink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-2.6	-2.6
Uplink Contour G/T (dB/K)	9.3	9.3	9.3	-7.4	-7.4
Uplink SFD (dBW/m2)	-77.3	-77.3	-77.3	-78	-78.0
Rain Rate (mm/hr)	95.0	95.0	95.0	95.0	95.0
DOWNLINK BEAM INFORMATION					
Downlink Beam Name	Composite	Pan Regional	Pan Regional	CBC	Pan Regional
Downlink Frequency (GHz)	11.575	11.575	11.575	11.460	11.460
Downlink Beam Polarization	Circular	Circular	Circular	Circular	Circular
Downlink Relative Contour Level (dB)	-6.0	-6.0	-6.0	-6.0	-6.0
Downlink Contour EIRP (dBW)	48.8	51.8	51.8	41.2	48.3
Rain Rate (mm/hr)	95.0	95.0	95.0	42.0	95.0
ADJACENT SATELLITE 1					
Satellite 1 Orbital Location	99.05W	99.05W	99.05W	995.05W	99.05W
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-16.5	-19.8	-21.2	-27.0	-20.0
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0
ADJACENT SATELLITE 2					
Satellite 1 Orbital Location	95.05W	95.05W	95.05W	95.05W	95.05W
Uplink Power Density (dBW/Hz)	-45.0	-45.0	-45.0	-45.0	-45.0
Uplink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0
Downlink EIRP Density (dBW/Hz)	-16.5	-19.8	-21.2	-27.0	-20.0
Downlink Polarization Advantage (dB)	0.0	0.0	0.0	0.0	0.0
CARRIER INFORMATION					
Carrier ID	36M0G7W	24M0G7W	24M0G7W	8M00G7W	8M00G7W
Carrier Modulation	QPSK	QPSK	QPSK	QPSK	QPSK
Peak to Peak Bandwidth of EDS (MHz)	N/A	N/A	N/A	N/A	N/A
Information Rate(kbps)	24575	16383	16383	5461	5461
Code Rate	1/2x188/204	1/2x188/204	1/2x188/204	1/2x188/204	1/2x188/204
Occupied Bandwidth(kHz)	30133	20089	20089	6696	6696
Allocated Bandwidth(kHz)	36000	24000	24000	8000	8000
Minimum C/N, Clear Sky (dB)	3.36	3.36	3.36	3.36	3.36
Minimum C/N, Rain (dB)	3.36	3.36	3.36	3.36	3.36
UPLINK EARTH STATION					
Earth Station Diameter (meters)	6.1	6.1	6.1	6.1	6.1
Earth Station Gain (dBi)	56.8	56.8	56.8	57.0	57.0
Earth Station Elevation Angle	20	20	20	20	20
DOWNLINK EARTH STATION					
Earth Station Diameter (meters)	3.7	3.0	2.4	1.8	2.4
Earth Station Gain (dBi)	50.8	48.9	47.2	44.4	47.1
Earth Station G/T (dB/K)	28.3	26.4	24.7	21.9	24.6
Earth Station Elevation Angle	20	20	20	20	20
LINK FADE TYPE	Clear Sky	Clear Sky	Clear Sky	Clear Sky	Clear Sky
UPLINK PERFORMANCE					
Uplink Earth Station EIRP (dBW)	73.7	69.0	69.0	74.1	67.0
Uplink Path Loss, Clear Sky (dB)	-207.4	-207.4	-207.4	-207.6	-207.6
Uplink Rain Attenuation	0.0	0.0	0.0	0.0	0.0
Satellite G/T(dB/K)	9.3	9.3	9.3	-7.4	-7.4
Boltzman Constant(dBW/K-Hz)	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-74.8	-73.0	-73.0	-68.3	-68.3
Uplink C/N(dB)	29.4	26.5	26.5	19.4	12.3
DOWNLINK PERFORMANCE					
Downlink EIRP per Carrier (dBW)	42.8	41.0	41.0	36.3	36.2
Antenna Pointing Error (dB)	-.5	-.5	-.5	-.5	-.5
Downlink Path Loss, Clear Sky (dB)	-205.7	-205.7	-205.7	-205.6	-205.6
Downlink Rain Attenuation	0.0	0.0	0.0	0.0	0.0
Earth Station G/T (dB/K)	28.3	26.4	24.7	21.9	24.6
Boltzman Constant(dBW / K - Hz)	228.6	228.6	228.6	228.6	228.6
Carrier Noise Bandwidth (dB-Hz)	-74.8	-73.0	-73.0	-68.3	-68.3
Downlink C / N(dB)	18.7	16.8	15.1	12.5	15.1
COMPOSITE LINK PERFORMANCE					
C/N Uplink (dB)	29.4	26.5	26.5	19.4	12.3
C/N Downlink (dB)	18.7	16.8	15.1	12.5	15.1
C/I Intermodulation (dB)	N/A	N/A	N/A	N/A	N/A
C/I Uplink Co-Channel (dB)*	27.0	27.0	27.0	27.0	27.0
C/I Downlink Co-Channel (dB)*	27.0	27.0	27.0	27.0	27.0
C/I Uplink Adjacent Satellite 1 (dB)	19.9	17.0	17.0	30.2	23.1
C/I Downlink Adjacent Satellite 1 (dB)	13.3	14.6	14.1	16.8	12.8
C/I Uplink Adjacent Satellite 2 (dB)	19.3	16.4	16.4	29.7	22.6
C/I Downlink Adjacent Satellite 2 (dB)	13.8	15.3	15.1	18.5	13.8
C/(N+I) Composite (dB)	8.9	8.7	8.3	9.6	7.0
Required System Margin (dB)	-1.0	-1.0	-1.0	-1.0	-1.0
Net C/(N+I) Composite (dB)	7.9	7.7	7.3	8.6	6.0
Minimum Required C/N (dB)	-3.4	-3.4	-3.4	-3.4	-3.4
Excess Link Margin (dB)	4.5	4.4	3.9	5.3	2.7
Number of Carriers	1.0	1.0	1.0	1.0	1.0
CARRIER DENSITY LEVELS					
Uplink Power Density (dBW/Hz)	-57.9	-60.9	-60.9	-51.2	-58.3
Downlink EIRP Density At Beam Peak (dBW/Hz)	-26.0	-26.0	-26.0	-26.0	-26.0