Engineering Statement

1 Introduction

Intelsat License LLC, as debtor in possession ("Intelsat"), seeks authority in this application to modify the Galaxy 12 (Call Sign S2422) satellite license to operate the satellite's beams over a new coverage area in the frequencies 3700-4200 MHz and 5925-6425 MHz at 129.0° W.L. (231.0° E.L.) in order to provide customer service. Intelsat expects to bias the satellite platform on a seasonal basis, with the summer season running from approximately May to October and the winter season running from approximately November to April. The summer and winter coverage maps are enclosed in Exhibits 5 and 6, respectively.

The characteristics of the satellite, as well as its compliance with the various provisions of Part 25 of the Federal Communications Commission's ("FCC" or "Commission") rules,[1] are provided in the remainder of this Engineering Statement, which updates the beam gain contours. In all other respects, the characteristics of Galaxy 12 are the same as those described in SAT-MOD-20180215-00017.

2 Satellite Overview

Galaxy 12 is an Orbital ATK GeoStar-2.2 satellite capable of operating in C-band frequencies listed below:

Direction	Frequency
Uplink	5925-6425 MHz
Downlink	3700-4200 MHz

The satellite provides the following coverage:

Beam	Coverage
C-band Beam (All Seasons)	North and Central America and the Caribbean

[1] Unless otherwise stated, all references to rule sections in this document refer to sections in Title 47 of the Code of Federal Regulations.

2.1 Satellite Characteristics

Galaxy 12 is a three-axis stabilized type satellite that has a rectangular outer body structure. The satellite utilizes two deployable solar array wings and one deployable antenna.

The Galaxy 12 satellite is composed of the following subsystems:

1) Thermal;
2) Power;
3) Attitude Control;
4) Propulsion;
5) Telemetry, Command, and Ranging ("TC&R");
6) Uplink Power Control ("ULPC"); and
7) Communications.

These subsystems maintain the correct position and attitude of the satellite; ensure that all internal units are maintained within the required temperature range; and ensure that the satellite can be commanded and controlled with a high level of reliability from launch to the end of its useful life. The satellite design incorporates redundancy in each of the various subsystems in order to avoid single-point failures.

The structural design of the satellite provides mechanical support for all subsystems, including the communication antennas, solar arrays, and thrusters. It also provides a stable platform for preserving the alignment of critical elements of the satellite.

2.2 Communication Subsystem

Galaxy 12 provides active communication channels in the C-band with a bandwidth of 36 MHz. The satellite's frequencies, polarization, and channel plan are provided in Schedule S, as well as the coverage contours and performance characteristics of Galaxy 12 beams. Exhibits 1 and 2 provide the beam parameters for the satellite's uplink and downlink beams, respectively. Schedule S beam designation for all beams is included in Exhibit 4.

2.3 Telemetry, Command and Ranging Subsystem

The TC&R subsystem provides the following functions:

1) acquisition, processing and transmission of satellite telemetry data;

2) reception and retransmission of ground station generated ranging signals; and

3) reception, processing and distribution of telecommands.

The Galaxy 12 command and telemetry channel frequencies are shown in Exhibit 3. The coverage patterns of the on-station command and telemetry beams are provided in Schedule S.

The coverage patterns of the emergency command and telemetry beams have gain contours that vary by less than 8 dB across the surface of the Earth and accordingly the gain at 8 dB below the peak falls beyond the edge of the Earth. Therefore, pursuant to Section 25.114(c)(4)(vi)(A), contours for these beams are not required to be provided and the associated GXT files have not been included in Schedule S. The Galaxy 12 command and telemetry subsystem performance is summarized in Exhibit 3.

2.4 Uplink Power Control Subsystem

Galaxy 12 utilizes two C-band channels for ULPC", antenna tracking, and ranging.

The coverage patterns of the ULPC beams have gain contours that vary by less than 8 dB across the surface of the Earth, and accordingly the gain at 8 dB below the peak falls beyond the edge of the Earth. Therefore, pursuant to Section 25.114(c)(4)(vi)(A), contours for these beams are not required to be provided and the associated GXT files have not been included in Schedule S. The Galaxy 12 ULPC frequencies and subsystem performance are summarized in Exhibit 3.

2.5 Satellite Station-Keeping

The spacecraft will be maintained within 0.05° of its nominal longitudinal position in the east-west direction in compliance with Section 25.210(j).

The attitude of the satellite 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, etc.).

3 Services

Galaxy 12 is a general-purpose communications satellite and has been designed to support various services offered within the Intelsat satellite system. Depending upon the needs of the users, the transponders on Galaxy 12 can accommodate digital and analog communications. Typical communication services include:

a) compressed digital video;

b) high speed digital data; and

c) digital single channel per carrier data channels.

Emission designators and allocated bandwidths for representative communication carriers are provided in Schedule S.

4 Power Flux Density

The power flux density ("PFD") limits for space stations operating in the 3700-4200 MHz band is contained in Section 25.208.

The maximum PFD levels for the Galaxy 12 transmissions were calculated for the 3700-4200 MHz band. The results are provided in Schedule S and show that the downlink power flux density levels of the Galaxy 12 carriers do not exceed the limits specified in Section 25.208.

5 Emission Compliance

Section 25.202(e) requires that the carrier frequency of each space station transmitter be maintained within 0.002% of the reference frequency. Galaxy 12 is designed to be compliant with the provisions of this rule.

Additionally, Intelsat will ensure that Galaxy 12 emissions comply with the provisions of Section 25.202(f).

6 International Telecommunication Union ("ITU") Filing

Galaxy 12 operations in the 3700-4200 MHz and 5925-6425 MHz frequency bands will operate under the United States' USASAT-24N ITU filing.

7 Coordination with Co-frequency Space Stations

Per Section 25.140, Galaxy 12 does not require any interference analysis or 2-degree analysis.

8 Orbital Debris Mitigation Plan

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

8.1 Satellite Hardware Design

The satellite is designed such that no debris will be released during normal operations. Intelsat has assessed the probability of collision with meteoroids and other debris. In order to limit the effects of such unlikely collisions critical satellite components are located inside the protective body of the satellite and are properly shielded. The satellite does not use any subsystems for end-of-life disposal that are not used for normal operations.

8.2 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.

8.3 Safe Flights 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. Galaxy 12 is not 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 also not aware of any system with an overlapping station-keeping volume with Galaxy 12 that is the subject of an ITU filing and that is either in orbit or progressing towards launch.

8.4 Post Mission Disposal

At the end of the mission, Intelsat intends to dispose of the satellite by moving it to an altitude of at least 267.9 kilometers above the geostationary arc as previously stated. Intelsat has reserved 20.95 kilograms of fuel for this purpose.

In calculating the disposal orbit, Intelsat has used simplifying assumptions as permitted under the Commission's Orbital Debris Report and Order.[2] The effective area to mass ratio (Cr*A/M) of the Galaxy 12 spacecraft is 0.031 m^2/kg, resulting in a minimum perigee disposal altitude under the Inter-Agency Space Debris Coordination Committee formula of 267.9 kilometers above the geostationary arc. Accordingly, the Galaxy 12 planned disposal orbit complies with the FCC's rules.

The reserved fuel figure was determined by the satellite manufacturer and provided for in the propellant budget. This figure was calculated considering 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 considered in these calculations.

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[2] *Mitigation of Orbital Debris*, Second Report and Order, 19 FCC Rcd 11567 (2004).

9 TC&R Control Earth Stations

Intelsat will conduct TC&R operations through one or more of the following earth stations: Napa, California; Ellenwood, Georgia; Castle Rock, Colorado; Fillmore, California, and Mountainside, Maryland. Additionally, Intelsat is capable of remotely controlling Galaxy 12 from its facilities in McLean, Virginia or in Long Beach, California.

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/ Giselle Creeser	August 28, 2020
	Date
Intelsat Director Spectrum Policy, Engineering	

EXHIBIT 1

COMMUNICATION SUBSYSTEM UPLINK BEAM PARAMETERS

Beam Name	C-Band Beam	C-Band Beam
Schedule S Beam ID	NCHU	NCVU
Frequency Band (MHz)	5925 – 6425	5925 – 6425
Polarization	Horizontal	Vertical
G/T (dB/K)	3.1	3.2
Minimum SFD-- (dBW/m^2)	-116.1	-116.2
Maximum SFD-- (dBW/m^2)	-81.1	-81.2

EXHIBIT 2

COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

Beam Name	C-Band Beam	C-Band Beam
Schedule S Beam ID	NCHD	NCVD
Frequency Band (MHz)	3700 - 4200	3700 - 4200
Polarization	Horizontal	Vertical
EIRP (dBW)	42.6	42.2
Maximum Beam Peak EIRP Density (dBW/4kHz)	3.1	2.7

EXHIBIT 3

TC&R SUBSYSTEM CHARACTERISTICS

Beam Name	Command Global	Command Omni	Command WG
Schedule S Beam ID	CMDG	CMDO	CMDW
Frequencies (MHz)	6424.5	6424.5	6424.5
Polarization	Vertical	RHCP	RHCP
Peak Flux Density at Command Threshold (dBW/m^2-Hz)	-90.0	-90.0	-90.0

Beam Name	Telemetry Global	Telemetry Omni	Telemetry WG	ULPC Global	Telemetry Omni	ULPC WG
Schedule S Beam ID	TMDG	TMDO	TMDW	ULDG	ULDO	ULDW
Frequencies (MHz)	4199.875	4199.875	4199.875	4198.0	4198.0	4198.0
Polarization	Horizontal	LHCP	LHCP	Horizontal	LHCP	LHCP
Maximum Channel EIRP (dBW)	19	19	19	19	19	19
Maximum Beam Peak EIRP Density (dBW/4kHz)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0

EXHIBIT 4

Beam Polarizations and GXT File Names

	Schedule S Beam Names							
	Linear Polarization				Circular Polarization			
Beam Designation	**Uplink**	**Uplink**	**Downlink**	**Downlink**	**Uplink**	**Uplink**	**Downlink**	**Downlink**
	(H-Pol.)	**(V-Pol.)**	**(H-Pol.)**	**(V-Pol.)**	**(LHCP)**	**(RHCP)**	**(LHCP)**	**(RHCP)**
C-Band Beams								
C-band Beam	NCHU	NCVU	NCHD	NCVD	----	----	----	----
Telemetry Omni	----	----	----	----	----	----	TMDO*	----
Telemetry Global	----	----	TMDG*	----	----	----	----	----
Telemetry WG	----	----	----	----	----	----	TMDW*	----
Command Global	----	CMDG*	----	----	----	----	----	----
Command Omni	----	----	----	----	----	CMDO*	----	----
Command WG	----	----	----	----	----	CMDW*	----	----
ULPC Global	----	----	ULDG*	----	----	----	----	----
ULPC Omni	----	----	----	----	----	----	ULDO*	----
ULPC WG	----	----	----	----	----	----	ULDW*	----

** GXT files are not provided for the indicated beams because their -8 dB gain contours extend beyond the edge of the Earth.*

EXHIBIT 5

Galaxy-12 Summer Season Coverages

Approximately May - October

C-Band Coverage Horizontal Downlink

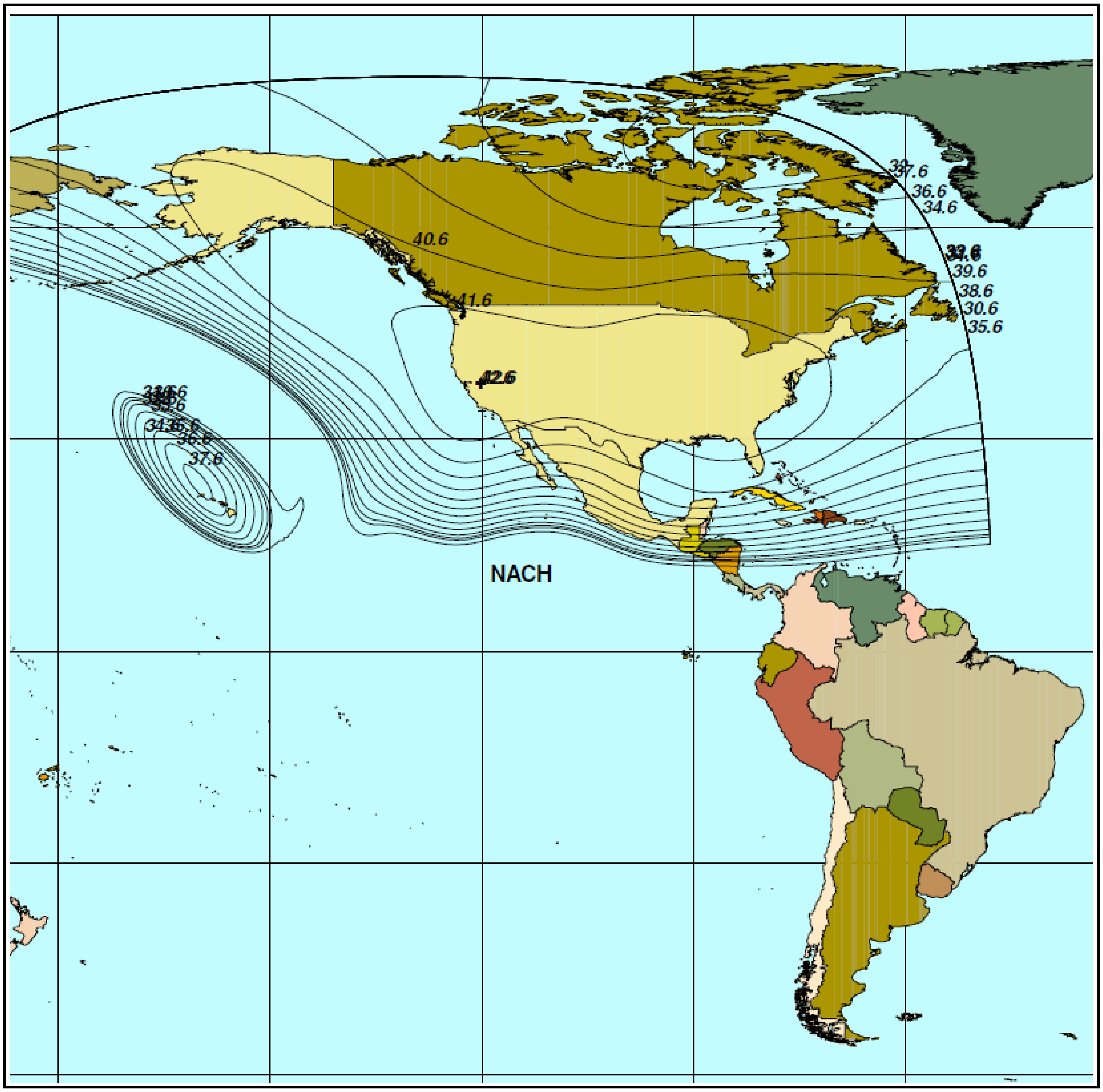

Figure 1: C-Band horizontal downlink

C-Band Coverage Vertical Downlink

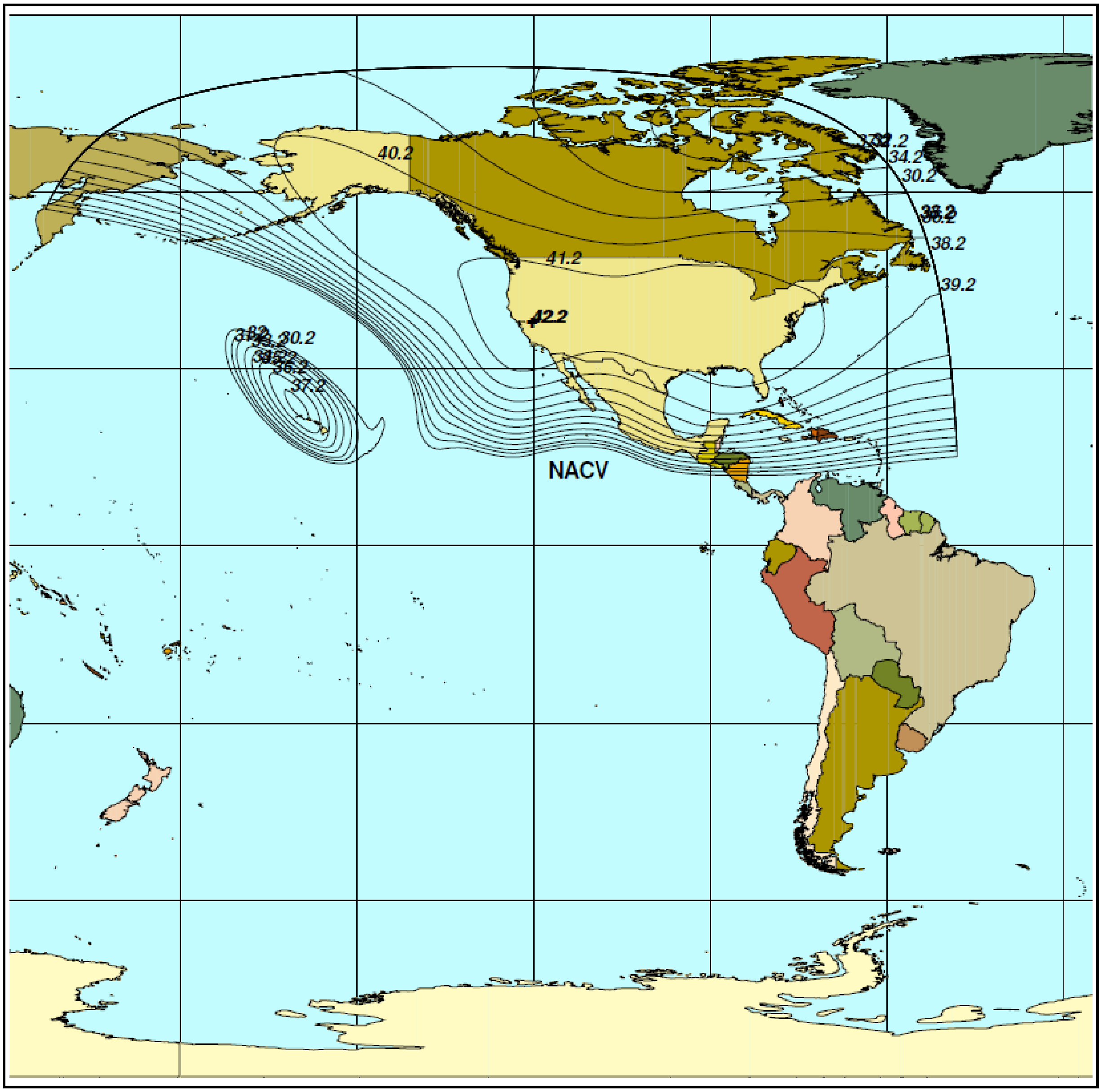

Figure 2: C-band vertical downlink

C-Band Coverage Horizontal Uplink

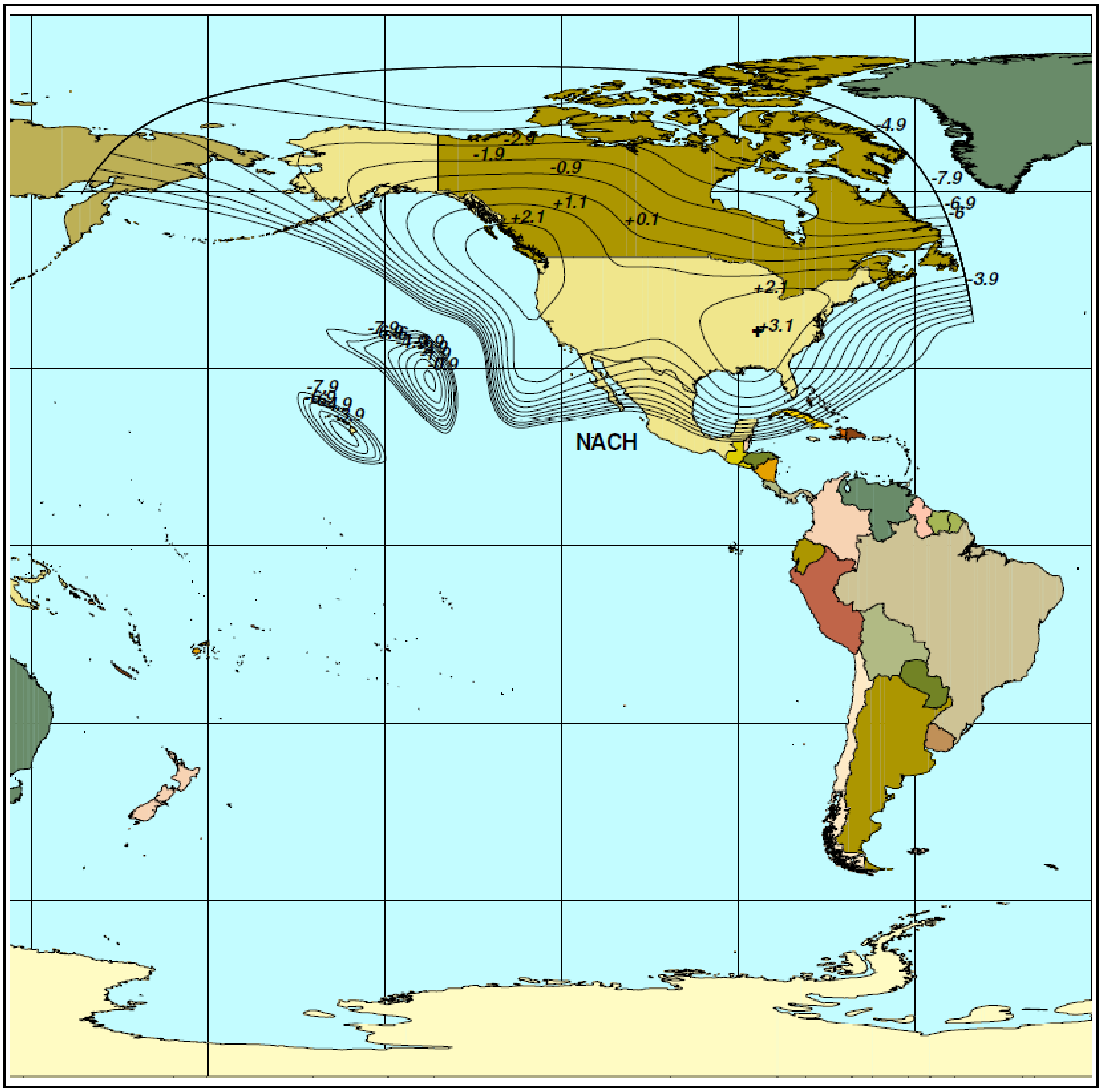

Figure 3: C-band horizontal uplink

C-Band Coverage Vertical Uplink

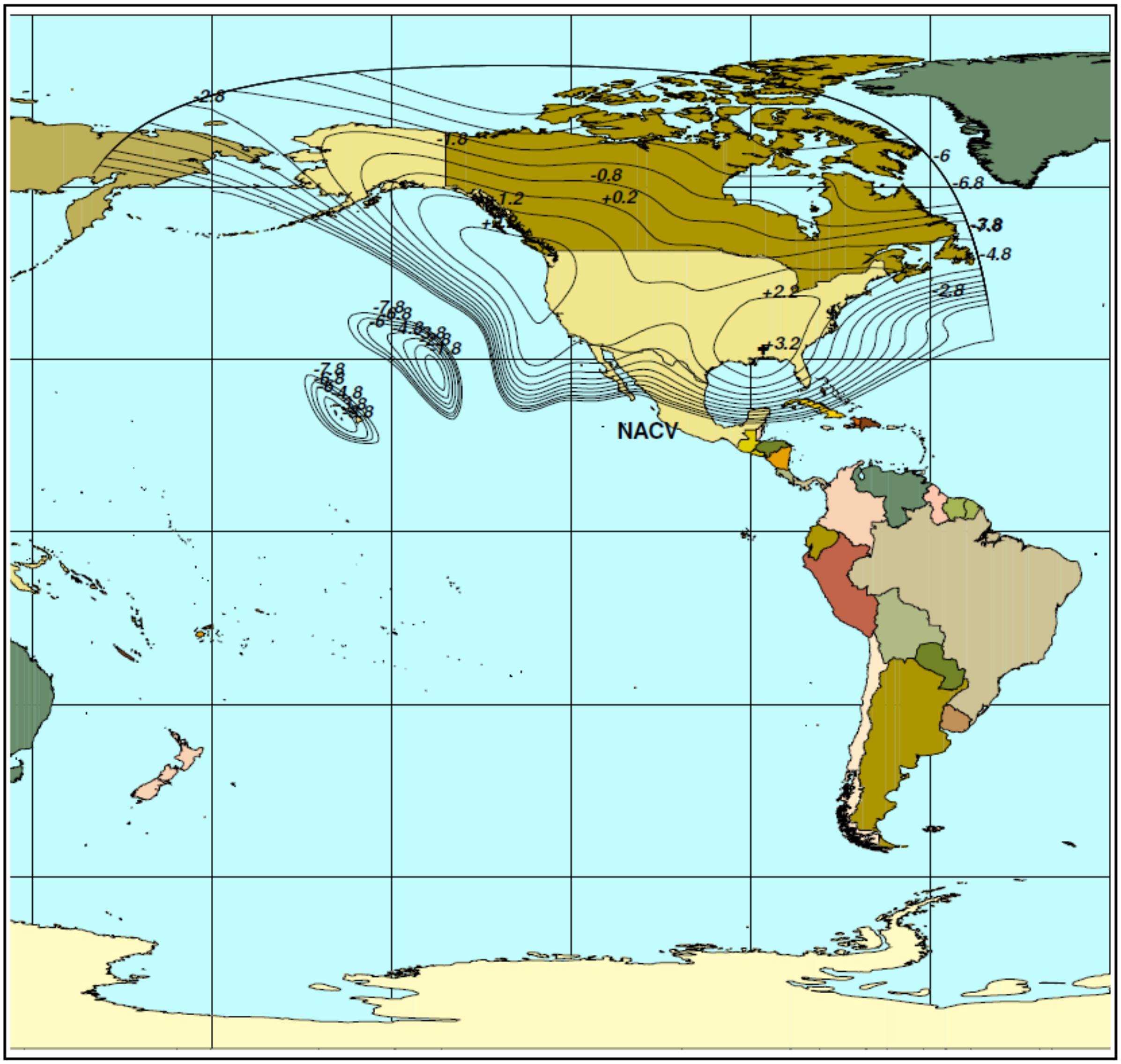

Figure 4: C-band vertical uplink

EXHIBIT 6

Galaxy-12 Winter Season Coverages

Approximately November - April

C-Band Coverage Horizontal Downlink

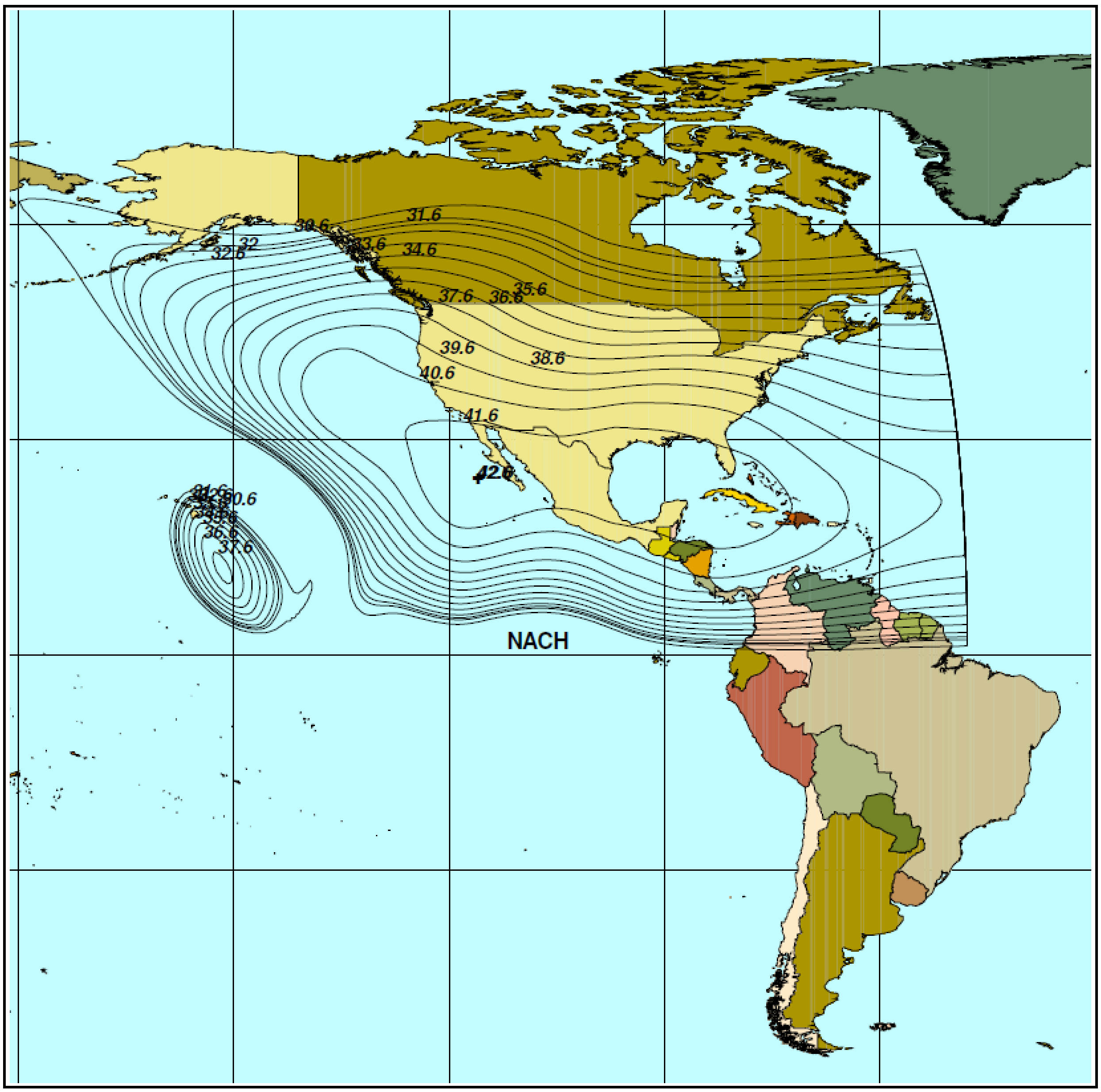

Figure 5: C-band horizontal downlink

C-Band Coverage Vertical Downlink

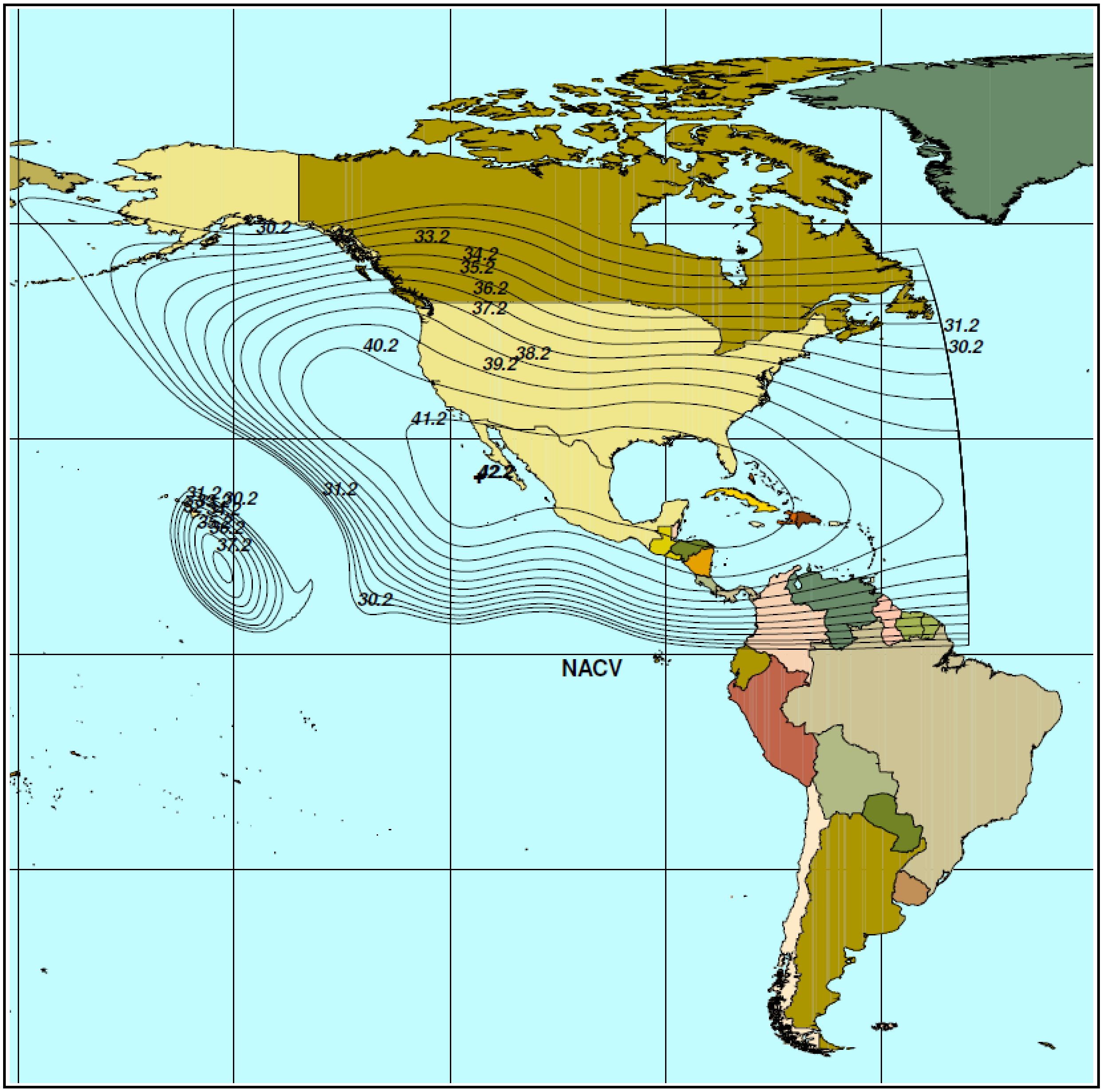

Figure 6: C-band vertical downlink

C-Band Coverage Horizontal Uplink

Figure 7: C-band horizontal uplink

C-Band Coverage Vertical Uplink

Figure 8: C-band horizontal uplink