

Attachment B – Regulatory Compliance Matrix

Reference	Reference Location	Topic / Reason for (n/a)
25.114(a)(1)	FCC Form 312, Schedule S, Attachment C	Overall context of filing
25.114(a)(2)	n/a	NGSO constellation
25.114(a)(3)	n/a	Application filed pursuant to two-step procedure
25.114(b)	Form 312	Waiver required by 47 U.S.C 304
25.114(c)(1)	Schedule-S	Applicant info
25.114(c)(2)	Schedule-S	Info for correspondence person
25.114(c)(3)	Schedule-S	Type of authorization
25.114(c)(4)(i)	Schedule-S	Channel frequency, bandwidth and polarization
25.114(c)(4)(ii)	Schedule-S	Maximum EIRP and EIRP density of TX beams
25.114(c)(4)(v)	Schedule-S	RX beam: G/T, SFD
25.114(c)(4)(vi)(A)	Schedule-S	GSO: Antenna Gain Contours
25.114(c)(4)(vi)(B)	n/a	NGSO: Antenna Gain Contours
25.114(c)(4)(vi)(C)	n/a	Shapeable Beams: Antenna Gain Contours
25.114(c)(4)(vi)(D)	n/a	Steerable, non-shapeable beams
25.114(c)(4)(vii)(A-C)	n/a	GSO: Large number of spot beams
25.114(c)(5)(i-v)	Schedule-S	GSO: Orbital parameters
25.114(c)(6)(i-ix)	n/a	NGSO: Orbital parameters
25.114(c)(7)	Schedule-S	Frequency Bands, Types of Service and Coverage Areas
25.114(c)(8)	Schedule-S, See 25.208	TX Beams: PFD
25.114(c)(10)	Schedule-S	Operational Lifetime
25.114(c)(11)	Schedule-S	Common Carrier Status
25.114(c)(13)	n/a	17/24 GHz BSS polarization isolation
25.114(d)(1)	Narrative, Attachment C - Section 2	Overall description
25.114(d)(6)	Narrative	Public Interest
25.114(d)(7)	See 25.140(a)	Interference Analysis
25.114(d)(8)	n/a	L-Band MSS
25.114(d)(9)	n/a	MSS: Multiple Satellites
25.114(d)(10)	n/a	L/S-Band MSS
25.114(d)(11)	n/a	DBS
25.114(d)(12)	n/a	NGSO FSS
25.114(d)(13)(i-ii)	n/a	DBSS
25.114(d)(14)(i-v)	Attachment D - Orbital Debris	Orbital Debris
25.114(d)(15)(i-v)	n/a	17/24 GHz BSS
25.114(d)(16)	n/a	17/24 GHz BSS
25.114(d)(17)	n/a	17/24 GHz BSS
25.114(d)(18)	n/a	17/24 GHz BSS

Reference	Reference Location	Topic / Reason for (n/a)
25.140(a)(3)(i)	Attachment C - Section 14	C-band limits
25.140(a)(3)(ii)	Attachment C - Section 14	Ku-band limits
25.140(a)(3)(iii)	Attachment C - Section 14	Ka-band limits
25.140(a)(3)(iv)	n/a	AP30B limits
25.140(a)(3)(v)	Attachment C - Section 14.1	2-degree spacing interference analysis
25.202(e)	Attachment C - Section 7	Frequency Tolerance
25.202(f)(1-3)	Attachment C - Section 8	Out of band - emissions
25.208(a-g)	Attachment C - Section 12	PFD Analysis
25.210(f)	Attachment C - Section 9	Full Frequency Reuse
25.210(j)	Narrative	EW Station keeping tolerance
25.283(a-c)	Attachment D - Orbital Debris	End-of-life Disposal
25.207	Attachment C - Section 10	Cessation of Emissions

Attachment C - Engineering Statement

1. Scope

This Attachment contains additional information regarding the EUTELSAT 172B satellite required by Section 25.114 and other sections of the Part 25 rules that cannot be entered into the Schedule S online submission system. Note that this technical information includes frequency bands for which ES 172 LLC does not seek operational authority from the Federal Communications Commission (“Commission”). This additional information is included for the Commission’s information and possible reference by a U.S. earth station applicant seeking to add EUTELSAT 172B as an authorized point of communication in bands not licensed by the Commission.

2. General Description (Section 25.114(d)(1))

The EUTELSAT 172B satellite will operate at the 172° E.L. orbital location and is intended as a replacement for the EUTELSAT 172A satellite that currently operates at 172° E.L. The EUTELSAT 172B satellite will provide a range of FSS services over the Pacific Ocean and to various countries within and bordering the Pacific Ocean using the C-band and Ku-band frequencies for service links and Ka-band frequencies for gateway links.

The EUTELSAT 172B satellite employs 14 C-band transponders and 40 Ku-band transponders using both linear polarizations thereby providing dual frequency reuse. The satellite has one C-band beam which provides coverage of the West coast of the United States and Canada and the Asia-Pacific region, including Australia, Japan, Indonesia, the Philippines and a portion of China. The satellite has five (5) regional Ku beams covering: North Pacific, South Pacific, South-West Pacific, South-East Pacific and North-East Asia.

In addition to the beams described, which effectively reproduce the capabilities of the EUTELSAT 172A satellite, this satellite introduces a High-Throughput Satellite (HTS) Ku-band payload with eleven (11) spot beams covering the North Pacific. Also, unique to the EUTELSAT 172B satellite are several Ka-band gateway beams, including one within U.S. territory at Hawaii. The Ka-band gateway beams are intended mostly to serve the new HTS Ku-band beams but are also able to connect with the regional Ku-band beams.

3. Spacecraft Overview

EUTELSAT 172B was manufactured and supplied by Airbus Defense and Space based on the Airbus Eurostar 3000e bus platform. The satellite is 3-axis stabilized and uses electrical propulsion for initial orbit raising, on-station control and end-of-life deorbit.

The EUTELSAT 172B satellite is a triple-mission satellite with three distinct payloads:

- A C-band payload delivering increased power and broader coverage to enhance service and tap into new growth markets in the Asia-Pacific region;
- A traditional Ku-band payload which will double capacity at 172° E.L. and connect five improved service areas: North Pacific, North-East Asia, South-East Pacific, South-West Pacific and South Pacific;
- An innovative HTS Ku-band payload designed for in-flight and maritime broadband services, with multiple user spots optimized to serve densely used Asian and trans-Pacific routes.

The spacecraft will operate in C-band, Ku-band and Ka-band at the frequencies listed below:

C-band	Uplink	5925 – 6425 MHz
	Downlink	3700 – 4200 MHz
Ku-band	Uplink	13.0 -13.25 GHz
		13.75 – 14.0 GHz
		14.0 – 14.5 GHz
	Downlink	10.95 – 11.20 GHz
		11.2 – 11.45 GHz
		11.45 – 11.7 GHz
		12.2 – 12.75 GHz
Ka-band	Uplink	27.5 – 29.15 GHz
	Downlink	18.4 – 19.2 GHz ¹

¹ The spacecraft also includes a Ka-band beacon with 100 Hz bandwidth at 19.202 GHz, the parameters of which are included in this application.

The spacecraft provides the following coverage (illustrations of the beam coverage areas is provided in Exhibit 4):

C-band	POR	Western North America, East Asia
Ku-band	North Pacific	East Asia, N Pacific Ocean, Western North America
	North-East Asia	China, Japan, Korea, Philippines
	South-West Pacific	SE Asia, Indonesia, Malaysia, Philippines
	South Pacific	Australia, New Zealand
	South-East Pacific	Hawaii, Fiji, American Samoa, Cook Islands, etc.
	High Throughput – North Pacific	11 beams covering aeronautical routes ²
Ka-band	Oahu, HI	Gateway Beam

4. Telemetry, Tracking and Control (TT&C)

The EUTELSAT 172B TT&C sub-system provides for communications during pre-launch, transfer orbit and on-station operations, as well as during spacecraft emergencies. Ku-band telecommand transmissions are received and Ku-band telemetry communications are transmitted by the spacecraft through a wide beam antenna when on-station and they are transmitted and received through a near omni-directional antenna during both transfer orbit and emergency operations.

TT&C communication channels have been selected consistent with Section 25.202(g). EUTELSAT 172B utilizes two Ku-band telemetry channels and one Ku-band commanding channel. The Ku-band telemetry channel center frequencies are 11200.6 MHz and 12250.1 MHz.³ The Ku-band commanding channel center frequency is 14499.8 MHz.⁴ TT&C operations will be conducted from an earth station facility located in Australia.

The TT&C beams used for orbital maneuvers and on-station emergencies 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) of the Commission's rules, contours for these beams are not required to be provided and the associated GXT files have not been included in Schedule S.

² Specific beam pointing locations are identified in Exhibit 5.

³ To the extent that a TT&C frequency may not be considered edge of band in any beam, consistent with Section 25.202(g) use of the frequency would cause no greater interference and require no greater protection from harmful interference than the communications traffic on the satellite.

⁴ TT&C for the EUTELSAT 172B satellite also will be conducted in other Ku-band frequencies pursuant to French authority for which ES 172 LLC does not seek Commission authorization.

Contact details for the control stations are provided below:

E172B TT&C station 1:

Perth LES
620 Gnangara Road
Landsdale, WA 6065
Australia

E172B TT&C station 2:

Speedcast Australia
12 Park Way
Mawson Lakes SA 5095
Australia

Satellite control center addresses and telephone numbers:

E172B Control Center

Address: Eutelsat
70 rue Balard
75015 Paris
France

E172B control responsible person: H. Schulze

Phone: +33 1 5398 3466
24/7 hours number: +33 1 5398 3445

E172B Operations Coordinator: P. Turner

Phone: +33 1 5398 3177

5. Uplink Power Control

EUTELSAT 172B utilizes two C-band, two Ku-band and one Ka-band ULPC channels. The C-band ULPC channel center frequencies are 4199.8 MHz and 4199.9 MHz. The Ku-band ULPC channel center frequencies are 11200.6 MHz and 12250.1 MHz. The Ka-band ULPC channel center frequency is 19202 MHz.

The coverage patterns of the C-band, Ku-band and Ka-band 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) of the Rules, contours for these beams are not required to be provided and the associated GXT files have not been included in Schedule S.

The C-band and Ka-band beacons have a bandwidth of 100 Hz. In the accompanying Schedule S, the bandwidth of the channels has been entered as 1000 Hz rather than 100 Hz due to a limitation of the precision of the channel bandwidth which does not accept values smaller than 1000 Hz. All other associated values, such as EIRP density, have been entered properly to reflect the 100 Hz emission bandwidth.

6. Frequency Plan

6.1 C-Band

The following tables list the uplink and downlink C-band channel planned for EUTELSAT 172B. This information is also provided in the accompanying Schedule S but is included here for completeness.

Table 1 C-Band Downlink Frequency Plan

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
CD1	36000	3720	V
CD2	36000	3740	H
CD3	36000	3760	V
CD4	36000	3780	H
CD5	72000	3820	V
CD6	72000	3840	H
CD7	72000	3900	V
CD8	72000	3920	H
CD9	72000	3980	V
CD10	72000	4000	H
CD11	72000	4060	V
CD12	72000	4080	H
CD13	72000	4140	V
CD14	72000	4160	H
CBH1	0.1	4198.9	H
CBV1	0.1	4199.9	V

Table 2 C-Band Uplink Frequency Plan

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
CU1	36000	5945	H
CU2	36000	5965	V
CU3	36000	5985	H
CU4	36000	6005	V
CU5	72000	6045	H
CU6	72000	6065	V
CU7	72000	6125	H
CU8	72000	6145	V
CU9	72000	6205	H
CU10	72000	6225	V
CU11	72000	6285	H
CU12	72000	6305	V
CU13	72000	6365	H
CU14	72000	6385	V

6.2 Ku-Band

The following tables list the uplink and downlink Ku-band channel planned for EUTELSAT 172B. This information is also provided in the accompanying Schedule S but is included here for completeness.

Table 3 Ku-Band Downlink Frequency Plan

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
B1D	54000	10981.25	H
B2D	54000	10981.25	V
B3D	54000	11043.75	H
B4D	54000	11043.75	V
B5D	54000	11106.25	H
B7D	54000	11168.75	H
C1D	54000	11231.25	H
C2D	54000	11231.25	V
C3D	54000	11293.75	H
C4D	54000	11293.75	V
C5D	54000	11356.25	H
C6D	54000	11356.25	V
C7D	54000	11418.75	H
C8D	54000	11418.75	V
D1D	54000	11481.25	H
D3D	54000	11543.75	H
D5D	54000	11606.25	H
D7D	54000	11668.75	H
F1D	36000	12531	H
F2D	36000	12571	H
F3D	36000	12611	H
F4D	36000	12651	H
F5D	36000	12691	H
F6D	36000	12731	H
G3D	27000	11533	V
G4D	27000	11563	V
G5D	27000	11593	V
G6D	27000	11623	V
G7D	27000	11653	V
G8D	27000	11683	V
H1D	36000	12531	H
H2D	36000	12571	H
R1D	54000	12281.25	H
R2D	54000	12343.75	H
R3D	54000	12406.25	H
R4D	54000	12468.75	H
R5D	54000	12656.25	V
R6D	54000	12718.75	V
S01D	170000	12340	V
S02D	170000	12530	V
TTD1	300	11200.6	L, R
TTD2	300	12250.1	L, R
KBV1	300	11200.6	V
KBH1	300	12250.1	H

Table 4 Ku-Band Uplink Frequency Plan

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
B1U	54000	14031.25	V
B2U	54000	14031.25	H
B3U	54000	14093.75	V
B4U	54000	14093.75	H
B5U	54000	14156.25	V
B7U	54000	14218.75	V
C1U	54000	13031.25	V
C2U	54000	13031.25	H
C3U	54000	13093.75	V
C4U	54000	13093.75	H
C5U	54000	13156.25	V
C6U	54000	13156.25	H
C7U	54000	13218.75	V
C8U	54000	13218.75	H
D1U	54000	13781.25	V
D3U	54000	13843.75	V
D5U	54000	13906.25	V
D7U	54000	13968.75	V
F1U	36000	14279	V
F2U	36000	14319	V
F3U	36000	14359	V
F4U	36000	14399	V
F5U	36000	14439	V
F6U	36000	14479	V
G3U	27000	14333	H
G4U	27000	14363	H
G5U	27000	14393	H
G6U	27000	14423	H
G7U	27000	14453	H
G8U	27000	14483	H
R1U	54000	14218.75	H
R2U	54000	14156.25	H
R3U	20000	14261.5	H
R4U	20000	14284	H
R5U	20000	14306.5	H
R6U	40000	14321	H
TCU	400	14499.8	L / R

6.3 Ka-Band

The following tables list the uplink and downlink Ka-band channel planned for EUTELSAT 172B. This information is also provided in the accompanying Schedule S but is included here for completeness.

Table 5 Ka-Band Downlink Frequency Plan

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
G01D	54000	18493.75	R
G02D	54000	18681.25	R
G03D	54000	18868.75	R
G04D	54000	18976.75	R
G05D	54000	19101.75	R
G06D	54000	18556.25	R
G07D	54000	18743.75	R
G08D	54000	18431.25	R
G09D	54000	18618.75	R
G10D	54000	18806.25	R
G11D	54000	19039.25	R
GE1D	20000	19167	R
GN1D	20000	19189.5	R
GS1D	40000	18922.75	R
GW1D	20000	19144.5	R
GWBD	0.1	19202	R

Table 6 Ka-Band Uplink Frequency Plan

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
G01U	170000	28160	R
G02U	170000	28350	R
G03U	170000	27780	L
G04U	170000	27970	L
G05U	170000	28540	L
G06U	170000	27590	R
G07U	170000	28540	R
G08U	170000	27970	R
G09U	170000	27780	R
G10U	170000	27590	L
G11U	170000	28160	L
GE1U	54000	28806.25	R
GE2U	54000	28868.75	R
GH1U	36000	28931	R
GH2U	36000	28971	R
GN1U	54000	28681.25	R
GN2U	54000	28743.75	R
GS1U	54000	28291.25	L
GS2U	54000	28353.75	L
GW1U	54000	29056.25	R
GW2U	54000	29118.75	R

7. Frequency Tolerance

The frequency tolerance requirements of Section 25.202(e) that the carrier frequency of each space station transmitter be maintained within 0.002% of the reference frequency will be met.

8. Out of Band Emissions

The out-of-band emission limits of Section 25.202(f)(1), (2) and (3) will be met.

9. Frequency Reuse

EUTELSAT 172B employs full frequency reuse on the C-band uplink and downlink by employing dual orthogonal linear polarization.

EUTELSAT 172B employs full frequency reuse on the Ku-band uplink and downlink by employing dual orthogonal linear polarization and frequency reuse across multiple regional and spot beams.

EUTELSAT 172B employs full frequency reuse on the Ka-band gateway uplink by employing dual orthogonal circular polarization. The satellite employs one polarization for the gateway downlinks.

10. Cessation of Emissions

All downlink transmissions can be turned on and off by ground telecommand, thereby causing cessation of emissions from the satellite, as required by Section 25.207 of the FCC’s rules.

11. ITU Filings

On EUTELSAT 172B, the different frequency bands will be operated under ITU filings according to following table.

Band	Direction	Spectrum Range	French Filing	US Filing ⁵
C-band	Uplink	5925 – 6425 MHz		USASAT-60A
	Downlink	3700 – 4200 MHz		USASAT-60A
Ku-band	Uplink	13.0 – 13.25 GHz	F-SAT-E-30B-172E	
		13.75 – 14.0 GHz	F-SAT-N-172E	
		14.0 – 14.5 GHz		USASAT-60A
	Downlink	10.95 – 11.20 GHz		USASAT-60A
		11.20 – 11.45 GHz	F-SAT-E-30B-172E	
		11.45 – 11.7 GHz		USASAT-60A
		12.2 – 12.75 GHz		USASAT-60A
Ka-band	Uplink	27.5 – 29.15 GHz	F-SAT-N-172E	
	Downlink	18.4 – 19.2 GHz	F-SAT-N-172E	

12. PFD Analysis

The power flux density (“PFD”) limits for space stations operating in the 3700–4200 MHz, 10950–11200 MHz, 11450–11700 MHz, 18300–18800 MHz and 18800–19300 MHz are specified in Section 25.208 of the Commission’s rules. Also, Sections 25.138(a)(6) and 25.140(a)(3)(iii) of the Commission’s rules specify a PFD limit of -118 dBW/m² /MHz for space stations operating in the 18300–18800 MHz band. The Commission’s rules do not specify a PFD limit in the 12200–12750 MHz band; however, there are PFD limits specified in rule No. 21.16 of the International Telecommunication Union (“ITU”) Radio Regulations. The maximum PFD levels for the EUTELSAT 172B transmissions were calculated for the bands 3700–4200 MHz, 10950–11200 MHz, 11450–11700 MHz, 12200–12750 MHz, 18300–18800 MHz and 18800–19300 MHz. The results are provided in Schedule S and show that the downlink power flux

⁵ USASAT-14K partially covers these bands as well. ES 172 LLC also has provided the Commission with additional ITU filing information (to be designated USASAT-60Y) covering the enhancements incorporated into the EUTELSAT 172B satellite.

density levels of the EUTELSAT 127B carriers do not exceed the limits specified in Sections 25.208, 25.138 and 25.140 of the Commission's rules, and those in rule No. 21.16 of the ITU Radio Regulations, as applicable.

13. Link Budgets

Link analysis for EUTELSAT 172B was conducted for a number of representative carriers in the C-band and Ku-band regional and HTS beams. For each of these links, it was assumed that the nearest satellite to EUTELSAT 172B was a hypothetical satellite operating at 170° E.L. and a hypothetical satellite operating at 174° E.L. In one set of the provided link budgets, the hypothetical satellites were assumed to have the same operating parameters as EUTELSAT 172B. In the other set of the link budgets, the hypothetical satellites operating at the maximum EIRP densities defined in Section 25.140.

The following assumptions were used in the link budget analysis:

- The link budgets are for clear sky operation.
- The clear sky link margins were chosen to provide sufficient link availability for the service(s).
- All transmitting and receiving earth stations have a cross-polarization isolation value of at least 27 dB within their main beam lobe.

The results of the analysis are shown in Exhibit 1.

14. Interference Analysis

In this section, the information specified in Section 25.140(a) is presented (as required by Section 25.114(d)(7)).

The downlink EIRP density of EUTELSAT 172B transmissions in the C-band will not exceed levels provided in Section 25.140(a)(3)(i), and associated uplink transmissions will not exceed applicable EIRP density envelopes in Sections 25.218 or 25.221(a)(1) unless the non-routine uplink and/or downlink operation is coordinated with operators of authorized co-frequency space stations at assigned locations within six degrees of EUTELSAT 172B at 172.0° E.L.

The downlink EIRP density of EUTELSAT 172B transmissions in the conventional or extended Ku-bands will not exceed levels provided in Section 25.140(a)(3)(ii), and associated uplink transmissions will not exceed applicable EIRP density envelopes in Sections 25.218, 25.222(a)(1), 25.226(a)(1) or 25.227(a)(1) unless the non-routine uplink and/or downlink operation is coordinated with operators of authorized co-frequency space stations at assigned locations within six degrees of EUTELSAT 172B at 172.0° E.L.

EUTELSAT 172B downlink transmissions in the conventional Ka-band will not generate power flux-density at the Earth's surface in excess of the levels provided in Section 25.140(a)(3)(iii), and that associated uplink operation will not exceed applicable EIRP density envelopes in Section 25.138(a) unless the non-routine uplink and/or downlink operation is coordinated with operators of authorized co-frequency space stations at assigned locations within six degrees of EUTELSAT 172B at 172.0° E.L.

14.1 Adjacent Satellite Link Analysis (Section 25.140(a)(3)(v))

The EUTELSAT 172B satellite will operate in bands addressed by Section 25.140(a)(3)(v). Since there are no commercial satellites operating within two degrees of EUTELSAT 172B, the impact of those operations on hypothetical satellites having the same operating characteristics as EUTELSAT 172B located at 170.0° E.L. and 174° E.L. was analyzed. The satellite at 170.0° E.L. was assumed to have two adjacent satellites separated by two degrees: EUTELSAT 172B at 172° E.L. and a hypothetical satellite having the same operating characteristics as EUTELSAT 172B located at 168° E.L. The satellite at 174° E.L. was assumed to have two adjacent satellites separated by two degrees: EUTELSAT 172B at 172° E.L. and a hypothetical satellite having the same operating characteristics as EUTELSAT 172B located at 176° E.L.

The link interference analysis demonstrating compatibility of EUTELSAT 172B with these hypothetical satellite systems was performed for representative carriers for Ka-band gateway links connected with HTS user links as well as the traditional Ku-band services. Other assumptions used in the analysis were as follows:

- The transmitting and receiving earth station antennas have off-axis co-polar gains that are compliant with the limits specified in Section 25.209(a) of the FCC's rules.
- The Adjacent Satellite Interference (ASI) is computed based on EIRP densities.
- The uplink RF power density for each adjacent satellite is based on the maximum allowed in that frequency band (the provided analysis shows both cases where the interfering satellites operate at maximum power densities and when the interfering satellites are operating at the same power density as the signal of interest)
- The downlink EIRP density for each adjacent satellite is based on the maximum allowed in that frequency band (the provided analysis shows both cases where the interfering satellites operate at maximum EIRP densities and when the interfering satellites are operating at the same EIRP density as the signal of interest).

The results of the HTS service and traditional Ku-band service interference analysis are shown in Exhibit 2 (for a hypothetical satellite at 170° E.L.) and Exhibit 3 (for a hypothetical satellite at 174° E.L.) and demonstrate that the operation of EUTELSAT 172B will permit the intended services for hypothetical satellites in slots two degrees away while maintaining sufficient link margin.

15. Sharing with NGSO FSS in the 28.6-29.1 GHz and 18.8-19.2 GHz Band

Under the FCC's band plan, the 28.6-29.1 GHz band is allocated to NGSO FSS on a primary basis and to the GSO FSS on a secondary basis. Stations operating as a secondary service cannot cause harmful interference, nor seek interference protection from, co-frequency stations of a primary service. EUTELSAT 172B's operations in the United States in this band will be consistent with the obligations of a secondary user.

Under the FCC's band plan, the 18.8-19.3 GHz band is available on a primary basis only to the NGSO FSS. A waiver is needed to allow the EUTELSAT 172B satellite to communicate with a U.S.-

licensed gateway earth station in the 18.8-19.2 GHz band. Operations with EUTELSAT 172B will not cause harmful interference to nor seek protection from authorized NGSO operations in this band.

The Commission has authorized WorldVu Satellite's OneWeb system (which has not yet been launched) and the O3b system (which is in orbit and operating) to serve the U.S. market in foregoing bands. With respect to OneWeb, Eutelsat has commenced discussions to coordinate the use of Ka-band frequencies between the OneWeb system and the entire Eutelsat satellite fleet, including EUTELSAT 172B. Eutelsat is confident that these discussions will result in a coordination agreement that includes EUTELSAT 172B access to the 18.8-19.2 GHz and 28.6-29.1 GHz bands.

With respect to O3b, the following analysis demonstrates compatibility with NGSO FSS operations in these band segments. The O3b constellation consists of 12 satellites in a medium-Earth orbit with an altitude of 8062 km and an inclination of 0° (an equatorial orbit). The satellites use steerable gateway spot beams which are oriented towards the gateways as the satellite traverses its orbit until the angle of arrival at the gateway falls below a minimum. An interference analysis is shown below that indicates that the EUTELSAT 172B and O3b networks can operate without causing harmful interference into each other.

To evaluate the impact of interference from EUTELSAT 172B into O3b and vice versa, it was necessary to compute the worst case angular separation (the smallest angle between the Eutelsat satellite and any of the satellites of the O3b constellation from the earth station location). A conservative assumption that simplifies that analysis was made that earth stations communicating with O3b and EUTELSAT 172B are collocated. For collocated earth stations on Oahu, HI, this analysis produced a minimum angular separation of 10.6° between EUTELSAT 172B and any O3b satellite. Other system parameters used in analysis are based on those in this Engineering Statement for EUTELSAT 172B and for the publicly available FCC filings from O3b.

The details of the calculations are shown in Table 7, which indicate that the operation of the EUTELSAT 172B system and corresponding HPT Gateway in the bands 28.6-29.1 GHz and 18.8-19.2 GHz will have a negligible impact on the O3b satellite network. Specifically, from Table 7 it can be seen that the calculated $\Delta T/T$ values are all well below 6%, with a maximum $\Delta T/T$ value of 0.4%. Furthermore, it should be noted that the uplink EIRP density reflects a rain margin of over 13 dB. The Ka-band uplink employs power control. Therefore, these uplink interference values would only be experienced a small fraction of time and in most cases, the interfering path would also experience significant rain fade. Finally, the uplink antenna sidelobe performance exceeds the Section 25.209 specification by over 10 dB. Similarly, it can be seen that the impact of O3b on the operation of the EUTELSAT 172B network results in a maximum $\Delta T/T$ value of 4.9%.

Table 7 Interference Analysis between EUTELSAT 172B and O3B Hawaii Earth Stations.

Victim Network		O3b	172B
Interfering Network		172B	O3b
Victim ES Latitude	deg	21.7	21.7
Victim ES Longitude	deg	-158.0	-158.0
Uplink			
Frequency	GHz	28.7	28.7
Interfering ES Uplink Power Density	dB(W/Hz)	-64.4	-54.5
Worst Case Angular Separation	deg	10.6	10.6
Interfering ES off-axis TX Gain	dB	6.3	6.3
Slant Range (interfering path)	km	9457.8	37222.0
Free Space Loss (interfering path)	dB	201.1	213.0
Victim Satellite RX Peak Antenna Gain	dBi	34.0	48.5
Victim Satellite RX System Noise Temperature	K	1000.0	794.3
N_0	dB(W/Hz)	-198.6	-199.6
I_0	dB(W/Hz)	-225.2	-212.7
I_0/N_0	dB	-26.6	-13.1
$\Delta T/T$	%	0.2	4.9
Downlink			
Frequency	GHz	18.9	18.9
Interfering Satellite DL EIRP Density	dB(W/Hz)	-25.9	-26.3
Slant Range (interfering path)	km	37222.0	9457.8
Free Space Loss (interfering path)	dB	209.4	197.5
Worst Case Angular Separation	deg	10.6	10.6
Victim ES off-axis RX Gain	dBi	6.3	6.3
Victim ES RX System Noise Temperature	K	230	300
N_0	dB(W/Hz)	-205.0	-203.8
I_0	dB(W/Hz)	-229.0	-217.5
I_0/N_0	dB	-24.0	-13.6
$\Delta T/T$	%	0.4	4.3

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

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

/s/

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EXHIBIT 1: EUTELSAT 172B LINK BUDGETS

172B Satellite - Maximum RF/EIRP Density Interference

UPLINK BEAM INFORMATION				
Uplink Beam Name		CUH/CUV	CUH/CUV	CUH/CUV
Uplink Frequency	GHz	6.2	6.2	6.2
Uplink Beam Polarization		LINEAR	LINEAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	-6.0	-8.0	-6.0
DOWNLINK BEAM INFORMATION				
Downlink Beam Name		CDH/CDV	CDH/CDV	CDH/CDV
Downlink Frequency	GHz	3.9	3.9	3.9
Downlink Beam Polarization		LINEAR	LINEAR	LINEAR
Downlink Satellite EIRP toward Earth Station	dBi	36.0	40.0	36.0
ADJACENT SATELLITE 1				
		Hypothetical 170° E.L.		
Satellite 1 Orbital Location	deg	170	170	170
Uplink Power Density	dB(W/Hz)	-38.7	-38.7	-38.7
Downlink EIRP Density	dB(W/Hz)	-33.0	-33.0	-33.0
ADJACENT SATELLITE 2				
		Hypothetical 174° E.L.		
Satellite 2 Orbital Location	deg	174	174	174
Uplink Power Density	dB(W/Hz)	-38.7	-38.7	-38.7
Downlink EIRP Density	dB(W/Hz)	-33.0	-33.0	-33.0
CARRIER INFORMATION				
Carrier ID		FWD Data	RTN Data	Dig TV
Information Rate	kbps	2476	371	45564
Modulation		QPSK	8PSK	8PSK
FEC Rate		0.33	0.54	0.51
Noise Bandwidth	kHz	3750.0	228.0	30000.0
Minimum C/N, Clear Sky	dB	0.1	5.7	5.2
UPLINK EARTH STATION				
Earth Station Diameter	meters	4.5	2.4	4.5
Earth Station Gain	dBi	47.4	42.0	47.4
Earth Station Latitude	deg	-37	-20.0	-37
Earth Station Longitude	deg	175	-160.0	175
Earth Station Elevation Angle	deg	47.0	50.6	47.0
DOWNLINK EARTH STATION				
Earth Station Diameter	meters	2.4	4.5	2.4
Earth Station G/T	dB/K	19.2	24.5	19.2
Earth Station Latitude	deg	-20.0	-37	-20.0
Earth Station Longitude	deg	-160.0	175	-160.0
Earth Station Elevation Angle	deg	50.6	47.0	50.6
UPLINK PERFORMANCE				
Uplink Earth Station EIRP	dBW	61.0	50.8	77.5
Uplink Free Space Loss	dB	199.7	199.7	199.7
Uplink Atmospheric Attenuation	dB	0.1	0.1	0.1
Satellite G/T	dB/K	-6.0	-8.0	-6.0
Carrier Noise Bandwidth	dB-Hz	65.7	53.6	74.8
Uplink C/N	dB	18.0	18.0	25.5
DOWNLINK PERFORMANCE				
Downlink EIRP per Carrier	dBW	20.9	12.8	36.0
Downlink Free Space Loss	dB	195.6	195.7	195.6
Downlink Atmospheric Attenuation	dB	0.1	0.1	0.1
Earth Station G/T	dB/K	19.2	24.5	19.2
Carrier Noise Bandwidth	dB-Hz	65.7	53.6	74.8
Downlink C/N	dB	7.2	16.5	13.3
COMPOSITE LINK PERFORMANCE				
C/N Uplink	dB	18.0	18.0	25.5
C/N Downlink	dB	7.2	16.5	13.3
C/I Uplink	dB	21.4	21.4	32.1
C/I Downlink	dB	15.9	15.9	19.9
C/I Uplink Adjacent Satellite 1	dB	13.8	15.8	21.3
C/I Downlink Adjacent Satellite 1	dB	6.0	15.3	12.1
C/I Uplink Adjacent Satellite 2	dB	13.8	15.8	21.3
C/I Downlink Adjacent Satellite 2	dB	6.0	15.3	12.1
C/(N+I) Composite	dB	0.8	7.4	7.0
Minimum Required C/N	dB	0.1	5.7	5.2
Excess Clear Sky Link Margin	dB	0.7	1.7	1.8

UPLINK BEAM INFORMATION						
Uplink Beam Name		NUH2/NUV2	EUH2/EUV2	AUH2/AUV2	AUH2/AUV2	AUH3/AUV3
Uplink Frequency	GHz	14.1	14.1	14.1	14.1	13.1
Uplink Beam Polarization		LINEAR	LINEAR	LINEAR	LINEAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	-1.0	-1.0	6.0	7.0	6.0
DOWNLINK BEAM INFORMATION						
Downlink Beam Name		EDH1/EDV1	NDH2/NDV2	ADH1/ADV1	ADH1/ADV1	ADH2/ADV2
Downlink Frequency	GHz	12.7	12.7	12.7	12.7	12.7
Downlink Beam Polarization		LINEAR	LINEAR	LINEAR	LINEAR	LINEAR
Downlink Satellite EIRP toward Earth Station	dB	43.0	45.0	54.0	54.0	54.0
ADJACENT SATELLITE 1						
Hypothetical 170° E.L.						
Satellite 1 Orbital Location	deg	170	170	170	170	170
Uplink Power Density	dB(W/Hz)	-50.0	-50.0	-50.0	-50.0	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-22.0	-22.0	-22.0	-22.0
ADJACENT SATELLITE 2						
Hypothetical 174° E.L.						
Satellite 2 Orbital Location	deg	174	174	174	174	174
Uplink Power Density	dB(W/Hz)	-50.0	-50.0	-50.0	-50.0	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-22.0	-22.0	-22.0	-22.0
CARRIER INFORMATION						
Carrier ID		FWD Data Worst	RTN Data Worst	FWD Data Best	RTN Data Best	DigTV
Information Rate	kbps	3595	402	7990	938	61433
Modulation		BPSK	8APSK	16APSK	16APSK	8APSK
FEC Rate		0.36	0.52	0.60	0.69	0.46
Noise Bandwidth	kHz	10000.0	256.00	3333.3	341.3	45000.0
Minimum C/N, Clear Sky	dB	-3.0	5.4	8.8	10.1	4.5
UPLINK EARTH STATION						
Earth Station Diameter	meters	4.5	1.2	4.5	1.2	4.5
Earth Station Gain	dB	54.6	43.1	54.6	43.1	54.0
Earth Station Latitude	deg	40.0	25.0	10.0	43.5	10.0
Earth Station Longitude	deg	-120.0	-120.0	125.0	143.0	125.0
Earth Station Elevation Angle	deg	8.1	11.3	35.1	32.0	35.1
DOWNLINK EARTH STATION						
Earth Station Diameter	meters	1.2	4.5	1.2	4.5	0.9
Earth Station G/T	dB/K	19.8	30.9	19.8	30.9	17.5
Earth Station Latitude	deg	25	40	43.5	10	43.5
Earth Station Longitude	deg	-120	-120	143	125	143
Earth Station Elevation Angle	deg	11.3	8.1	32.0	35.1	32.0
UPLINK PERFORMANCE						
Uplink Earth Station EIRP	dBW	70.7	51.1	58.4	47.6	69.0
Uplink Free Space Loss	dB	207.6	207.6	207.1	207.1	206.4
Uplink Atmospheric Attenuation	dB	0.3	0.3	0.3	0.3	0.3
Satellite G/T	dB/K	-1.0	-1.0	6.0	7.0	6.0
Carrier Noise Bandwidth	dB-Hz	70.0	54.1	65.2	55.3	76.5
Uplink C/N	dB	20.4	16.7	20.4	20.4	20.3
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier	dBW	33.2	15.7	39.5	29.6	50.1
Downlink Free Space Loss	dB	206.7	206.8	206.2	206.2	206.2
Downlink Atmospheric Attenuation	dB	0.2	0.2	0.2	0.2	0.2
Earth Station G/T	dB/K	19.8	30.9	19.8	30.9	17.5
Carrier Noise Bandwidth	dB-Hz	70.0	54.1	65.2	55.3	76.5
Downlink C/N	dB	4.7	14.2	16.2	27.4	13.2
COMPOSITE LINK PERFORMANCE						
C/N Uplink	dB	20.4	16.7	20.4	20.4	20.3
C/N Downlink	dB	4.7	14.2	16.2	27.4	13.2
C/I Uplink	dB	23.8	17.5	21.2	21.2	24.1
C/I Downlink	dB	18.5	14.7	18.0	18.4	17.6
C/I Uplink Adjacent Satellite 1	dB	29.5	25.9	22.7	21.8	22.0
C/I Downlink Adjacent Satellite 1	dB	5.0	14.9	16.7	28.3	14.2
C/I Uplink Adjacent Satellite 2	dB	29.6	25.9	22.7	21.8	22.0
C/I Downlink Adjacent Satellite 2	dB	5.0	15.0	16.7	28.3	14.2
C/(N+I) Composite	dB	0.0	7.4	9.6	13.1	7.8
Minimum Required C/N	dB	-3.0	5.4	8.8	10.1	4.5
Excess Clear Sky Link Margin	dB	3.0	2.0	0.8	3.0	3.3

UPLINK BEAM INFORMATION					
Uplink Beam Name		OAUL/OAUR	HUH2	OAUL/OAUR	HUH2
Uplink Frequency	GHz	28.2	14.2	28.2	14.2
Uplink Beam Polarization		CIRCULAR	LINEAR	CIRCULAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	13.2	12.2	13.2	12.2
DOWNLINK BEAM INFORMATION					
Downlink Beam Name		HDV4	OADR	HDV4	OADR
Downlink Frequency	GHz	12.7	19.0	12.7	19.0
Downlink Beam Polarization		LINEAR	CIRCULAR	LINEAR	CIRCULAR
Downlink Satellite EIRP toward Earth Station	dBi	53.9	45.3	53.9	45.3
ADJACENT SATELLITE 1					
Hypothetical 170° E.L.					
Satellite 1 Orbital Location	deg	170	170	170	170
Uplink Power Density	dB(W/Hz)	-56.5	-50.0	-56.5	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-15.6	-22.0	-15.6
ADJACENT SATELLITE 2					
Hypothetical 174° E.L.					
Satellite 2 Orbital Location	deg	174	174	174	174
Uplink Power Density	dB(W/Hz)	-56.5	-50.0	-56.5	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-15.6	-22.0	-15.6
CARRIER INFORMATION					
Carrier ID		HTS FWD	HTS RTN	HTS FWD	HTS RTN
Information Rate	kbps	19500	1672	48387	4703
Modulation		QPSK	QPSK	8APSK	8APSK
FEC Rate		0.33	0.28	0.54	0.52
Noise Bandwidth	kHz	30000.0	3000.0	30000.0	3000.0
Minimum C/N, Clear Sky	dB	0.1	-0.8	5.6	5.4
UPLINK EARTH STATION					
Earth Station Diameter	meters	9.2	0.5	9.2	1.2
Earth Station Gain	dBi	64.1	35.6	64.1	43.2
Earth Station Latitude	deg	21.3	45.0	21.3	45.0
Earth Station Longitude	deg	-157.9	-137.0	-157.9	-137.0
Earth Station Elevation Angle	deg	47.9	18.2	47.9	18.2
DOWNLINK EARTH STATION					
Earth Station Diameter	meters	0.5	9.2	1.2	9.2
Earth Station G/T	dB/K	11.5	38.6	19.1	38.6
Earth Station Latitude	deg	45	21.32	45	21.32
Earth Station Longitude	deg	-137	-157.87	-137	-157.87
Earth Station Elevation Angle	deg	18.2	47.9	18.2	47.9
UPLINK PERFORMANCE					
Uplink Earth Station EIRP	dBW	63.3	40.7	63.3	48.3
Uplink Free Space Loss	dB	212.9	207.5	212.9	207.5
Uplink Atmospheric Attenuation	dB	1.5	0.3	1.5	0.3
Satellite G/T	dB/K	13.2	12.2	13.2	12.2
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Uplink C/N	dB	16.0	9.0	16.0	16.6
DOWNLINK PERFORMANCE					
Downlink EIRP per Carrier	dBW	47.2	32.7	47.2	32.7
Downlink Free Space Loss	dB	206.5	209.5	206.5	209.5
Downlink Atmospheric Attenuation	dB	0.2	1.00	0.2	1.00
Earth Station G/T	dB/K	11.5	38.6	19.10	38.6
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Downlink C/N	dB	5.8	24.7	13.4	24.7
COMPOSITE LINK PERFORMANCE					
C/N Uplink	dB	16.0	9.0	16.0	16.6
C/N Downlink	dB	5.8	24.7	13.4	24.7
C/I Uplink	dB	25.7	12.4	25.7	12.4
C/I Downlink	dB	12.0	20.3	12.0	20.3
C/I Uplink Adjacent Satellite 1	dB	24.9	4.3	24.9	11.9
C/I Downlink Adjacent Satellite 1	dB	6.8	25.9	14.4	25.9
C/I Uplink Adjacent Satellite 2	dB	24.9	4.3	24.9	11.9
C/I Downlink Adjacent Satellite 2	dB	6.8	26.0	14.4	26.0
C/(N+I) Composite	dB	1.1	0.2	6.6	6.4
Minimum Required C/N	dB	0.1	-0.8	5.6	5.4
Excess Clear Sky Link Margin	dB	1.0	1.0	1.0	1.0

172B Satellite – Interferers RF/EIRP Densities Match Signal of Interest

UPLINK BEAM INFORMATION				
Uplink Beam Name		CUH/CUV	CUH/CUV	CUH/CUV
Uplink Frequency	GHz	6.2	6.2	6.2
Uplink Beam Polarization		LINEAR	LINEAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	-6.0	-8.0	-6.0
DOWNLINK BEAM INFORMATION				
Downlink Beam Name		CDH/CDV	CDH/CDV	CDH/CDV
Downlink Frequency	GHz	3.9	3.9	3.9
Downlink Beam Polarization		LINEAR	LINEAR	LINEAR
Downlink Satellite EIRP toward Earth Station	dBi	36.0	40.0	36.0
ADJACENT SATELLITE 1				
		Hypothetical 170° E.L.		
Satellite 1 Orbital Location	deg	170	170	170
Uplink Power Density	dB(W/Hz)	-52.2	-44.8	-44.7
Downlink EIRP Density	dB(W/Hz)	-44.8	-40.8	-38.8
ADJACENT SATELLITE 2				
		Hypothetical 174° E.L.		
Satellite 2 Orbital Location	deg	174	174	174
Uplink Power Density	dB(W/Hz)	-52.2	-44.8	-44.7
Downlink EIRP Density	dB(W/Hz)	-44.8	-40.8	-38.8
CARRIER INFORMATION				
Carrier ID		FWD Data	RTN Data	Dig TV
Information Rate	kbps	5444	533	68148
Modulation		QPSK	16APSK	16APSK
FEC Rate		0.73	0.58	0.57
Noise Bandwidth	kHz	3750.0	228.0	30000.0
Minimum C/N, Clear Sky	dB	4.9	8.6	8.3
UPLINK EARTH STATION				
Earth Station Diameter	meters	4.5	2.4	4.5
Earth Station Gain	dBi	47.4	42.0	47.4
Earth Station Latitude	deg	-37	-20.0	-37
Earth Station Longitude	deg	175	-160.0	175
Earth Station Elevation Angle	deg	47.0	50.6	47.0
DOWNLINK EARTH STATION				
Earth Station Diameter	meters	2.4	4.5	2.4
Earth Station G/T	dB/K	19.2	24.5	19.2
Earth Station Latitude	deg	-20.0	-37	-20.0
Earth Station Longitude	deg	-160.0	175	-160.0
Earth Station Elevation Angle	deg	50.6	47.0	50.6
UPLINK PERFORMANCE				
Uplink Earth Station EIRP	dBW	61.0	50.8	77.5
Uplink Free Space Loss	dB	199.7	199.7	199.7
Uplink Atmospheric Attenuation	dB	0.1	0.1	0.1
Satellite G/T	dB/K	-6.0	-8.0	-6.0
Carrier Noise Bandwidth	dB-Hz	65.7	53.6	74.8
Uplink C/N	dB	18.0	18.0	25.5
DOWNLINK PERFORMANCE				
Downlink EIRP per Carrier	dBW	20.9	12.8	36.0
Downlink Free Space Loss	dB	195.6	195.7	195.6
Downlink Atmospheric Attenuation	dB	0.1	0.1	0.1
Earth Station G/T	dB/K	19.2	24.5	19.2
Carrier Noise Bandwidth	dB-Hz	65.7	53.6	74.8
Downlink C/N	dB	7.2	16.5	13.3
COMPOSITE LINK PERFORMANCE				
C/N Uplink	dB	18.0	18.0	25.5
C/N Downlink	dB	7.2	16.5	13.3
C/I Uplink	dB	21.4	21.4	32.1
C/I Downlink	dB	15.9	15.9	19.9
C/I Uplink Adjacent Satellite 1	dB	27.3	21.9	27.3
C/I Downlink Adjacent Satellite 1	dB	17.8	23.1	17.8
C/I Uplink Adjacent Satellite 2	dB	27.3	21.9	27.3
C/I Downlink Adjacent Satellite 2	dB	17.9	23.1	17.9
C/(N+I) Composite	dB	5.6	10.3	10.1
Minimum Required C/N	dB	4.9	8.6	8.3
Excess Clear Sky Link Margin	dB	0.7	1.7	1.8

UPLINK BEAM INFORMATION						
Uplink Beam Name		NUH2/NUV2	EUH2/EUV2	AUH2/AUV2	AUH2/AUV2	AUH3/AUV3
Uplink Frequency	GHz	14.1	14.1	14.1	14.1	13.1
Uplink Beam Polarization		LINEAR	LINEAR	LINEAR	LINEAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	-1.0	-1.0	6.0	7.0	6.0
DOWNLINK BEAM INFORMATION						
Downlink Beam Name		EDH1/EDV1	NDH2/NDV2	ADH1/ADV1	ADH1/ADV1	ADH2/ADV2
Downlink Frequency	GHz	12.7	12.7	12.7	12.7	12.7
Downlink Beam Polarization		LINEAR	LINEAR	LINEAR	LINEAR	LINEAR
Downlink Satellite EIRP toward Earth Station	dB	43.0	45.0	54.0	54.0	54.0
ADJACENT SATELLITE 1						
		Hypothetical 170° E.L.				
Satellite 1 Orbital Location	deg	170	170	170	170	170
Uplink Power Density	dB(W/Hz)	-53.8	-46.1	-61.4	-50.8	-61.5
Downlink EIRP Density	dB(W/Hz)	-36.8	-38.4	-25.7	-25.7	-26.4
ADJACENT SATELLITE 2						
		Hypothetical 174° E.L.				
Satellite 2 Orbital Location	deg	174	174	174	174	174
Uplink Power Density	dB(W/Hz)	-53.8	-46.1	-61.4	-50.8	-61.5
Downlink EIRP Density	dB(W/Hz)	-36.8	-38.4	-25.7	-25.7	-26.4
CARRIER INFORMATION						
Carrier ID		FWD Data Worst	RTN Data Worst	FWD Data Best	RTN Data Best	DigTV
Information Rate	kbps	7900	498	9493	972	80575
Modulation		QPSK	8APSK	16APSK	16APSK	8APSK
FEC Rate		0.40	0.65	0.71	0.71	0.60
Noise Bandwidth	kHz	10000.0	256.00	3333.3	341.3	45000.0
Minimum C/N, Clear Sky	dB	1.1	7.0	10.4	10.4	6.4
UPLINK EARTH STATION						
Earth Station Diameter	meters	4.5	1.2	4.5	1.2	4.5
Earth Station Gain	dB	54.6	43.1	54.6	43.1	54.0
Earth Station Latitude	deg	40.0	25.0	10.0	43.5	10.0
Earth Station Longitude	deg	-120.0	-120.0	125.0	143.0	125.0
Earth Station Elevation Angle	deg	8.1	11.3	35.1	32.0	35.1
DOWNLINK EARTH STATION						
Earth Station Diameter	meters	1.2	4.5	1.2	4.5	0.9
Earth Station G/T	dB/K	19.8	30.9	19.8	30.9	17.5
Earth Station Latitude	deg	25	40	43.5	10	43.5
Earth Station Longitude	deg	-120	-120	143	125	143
Earth Station Elevation Angle	deg	11.3	8.1	32.0	35.1	32.0
UPLINK PERFORMANCE						
Uplink Earth Station EIRP	dBW	70.7	51.1	58.4	47.6	69.0
Uplink Free Space Loss	dB	207.6	207.6	207.1	207.1	206.4
Uplink Atmospheric Attenuation	dB	0.3	0.3	0.3	0.3	0.3
Satellite G/T	dB/K	-1.0	-1.0	6.0	7.0	6.0
Carrier Noise Bandwidth	dB-Hz	70.0	54.1	65.2	55.3	76.5
Uplink C/N	dB	20.4	16.7	20.4	20.4	20.3
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier	dBW	33.2	15.7	39.5	29.6	50.1
Downlink Free Space Loss	dB	206.7	206.8	206.2	206.2	206.2
Downlink Atmospheric Attenuation	dB	0.2	0.2	0.2	0.2	0.2
Earth Station G/T	dB/K	19.8	30.9	19.8	30.9	17.5
Carrier Noise Bandwidth	dB-Hz	70.0	54.1	65.2	55.3	76.5
Downlink C/N	dB	4.7	14.2	16.2	27.4	13.2
COMPOSITE LINK PERFORMANCE						
C/N Uplink	dB	20.4	16.7	20.4	20.4	20.3
C/N Downlink	dB	4.7	14.2	16.2	27.4	13.2
C/I Uplink	dB	23.8	17.5	21.2	21.2	24.1
C/I Downlink	dB	18.5	14.7	18.0	18.4	17.6
C/I Uplink Adjacent Satellite 1	dB	33.4	21.9	34.1	22.6	33.5
C/I Downlink Adjacent Satellite 1	dB	19.8	31.3	20.5	32.1	18.6
C/I Uplink Adjacent Satellite 2	dB	33.4	22.0	34.1	22.6	33.5
C/I Downlink Adjacent Satellite 2	dB	19.8	31.4	20.4	32.0	18.6
C/(N+I) Composite	dB	4.1	9.0	11.2	13.4	9.7
Minimum Required C/N	dB	1.1	7.0	10.4	10.4	6.4
Excess Clear Sky Link Margin	dB	3.0	2.0	0.8	3.0	3.3

UPLINK BEAM INFORMATION					
Uplink Beam Name		OAUL/OAUR	HUH2	OAUL/OAUR	HUH2
Uplink Frequency	GHz	28.2	14.2	28.2	14.2
Uplink Beam Polarization		CIRCULAR	LINEAR	CIRCULAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	13.2	12.2	13.2	12.2
DOWNLINK BEAM INFORMATION					
Downlink Beam Name		HDV4	OADR	HDV4	OADR
Downlink Frequency	GHz	12.7	19.0	12.7	19.0
Downlink Beam Polarization		LINEAR	CIRCULAR	LINEAR	CIRCULAR
Downlink Satellite EIRP toward Earth Station	dB	53.9	45.3	53.9	45.3
ADJACENT SATELLITE 1					
Hypothetical 170° E.L.					
Satellite 1 Orbital Location	deg	170	170	170	170
Uplink Power Density	dB(W/Hz)	-75.6	-59.6	-75.6	-59.6
Downlink EIRP Density	dB(W/Hz)	-27.6	-32.1	-27.6	-32.1
ADJACENT SATELLITE 2					
Hypothetical 174° E.L.					
Satellite 2 Orbital Location	deg	174	174	174	174
Uplink Power Density	dB(W/Hz)	-75.6	-59.6	-75.6	-59.6
Downlink EIRP Density	dB(W/Hz)	-27.6	-32.1	-27.6	-32.1
CARRIER INFORMATION					
Carrier ID		HTS FWD	HTS RTN	HTS FWD	HTS RTN
Information Rate	kbps	28816	4134	58161	7108
Modulation		QPSK	QPSK	8APSK	16APSK
FEC Rate		0.48	0.69	0.65	0.59
Noise Bandwidth	kHz	30000.0	3000.0	30000.0	3000.0
Minimum C/N, Clear Sky	dB	2.3	4.5	7.0	8.7
UPLINK EARTH STATION					
Earth Station Diameter	meters	9.2	0.5	9.2	1.2
Earth Station Gain	dB	64.1	35.6	64.1	43.2
Earth Station Latitude	deg	21.3	45.0	21.3	45.0
Earth Station Longitude	deg	-157.9	-137.0	-157.9	-137.0
Earth Station Elevation Angle	deg	47.9	18.2	47.9	18.2
DOWNLINK EARTH STATION					
Earth Station Diameter	meters	0.5	9.2	1.2	9.2
Earth Station G/T	dB/K	11.5	38.6	19.1	38.6
Earth Station Latitude	deg	45	21.32	45	21.32
Earth Station Longitude	deg	-137	-157.87	-137	-157.87
Earth Station Elevation Angle	deg	18.2	47.9	18.2	47.9
UPLINK PERFORMANCE					
Uplink Earth Station EIRP	dBW	63.3	40.7	63.3	48.3
Uplink Free Space Loss	dB	212.9	207.5	212.9	207.5
Uplink Atmospheric Attenuation	dB	1.5	0.3	1.5	0.3
Satellite G/T	dB/K	13.2	12.2	13.2	12.2
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Uplink C/N	dB	16.0	9.0	16.0	16.6
DOWNLINK PERFORMANCE					
Downlink EIRP per Carrier	dBW	47.2	32.7	47.2	32.7
Downlink Free Space Loss	dB	206.5	209.5	206.5	209.5
Downlink Atmospheric Attenuation	dB	0.2	1.00	0.2	1.00
Earth Station G/T	dB/K	11.5	38.6	19.10	38.6
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Downlink C/N	dB	5.8	24.7	13.4	24.7
COMPOSITE LINK PERFORMANCE					
C/N Uplink	dB	16.0	9.0	16.0	16.6
C/N Downlink	dB	5.8	24.7	13.4	24.7
C/I Uplink	dB	25.7	12.4	25.7	12.4
C/I Downlink	dB	12.0	20.3	12.0	20.3
C/I Uplink Adjacent Satellite 1	dB	43.9	13.9	43.9	21.5
C/I Downlink Adjacent Satellite 1	dB	12.4	42.4	20.0	42.4
C/I Uplink Adjacent Satellite 2	dB	44.0	13.9	44.0	21.5
C/I Downlink Adjacent Satellite 2	dB	12.4	42.5	20.0	42.5
C/(N+I) Composite	dB	3.3	5.5	8.0	9.7
Minimum Required C/N	dB	2.3	4.5	7.0	8.7
Excess Clear Sky Link Margin	dB	1.0	1.0	1.0	1.0

EXHIBIT 2: ADJACENT SATELLITE (170° E. L.) LINK BUDGETS

Hypothetical 170 East Satellite - Maximum RF/EIRP Density Interference

UPLINK BEAM INFORMATION						
Uplink Beam Name		NUH2/NUV2	EUH2/EUV2	AUH2/AUV2	AUH2/AUV2	AUH3/AUV3
Uplink Frequency	GHz	14.1	14.1	14.1	14.1	13.1
Uplink Beam Polarization		LINEAR	LINEAR	LINEAR	LINEAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	-1.0	-1.0	6.0	7.0	6.0
DOWNLINK BEAM INFORMATION						
Downlink Beam Name		EDH1/EDV1	NDH2/NDV2	ADH1/ADV1	ADH1/ADV1	ADH2/ADV2
Downlink Frequency	GHz	12.7	12.7	12.7	12.7	12.7
Downlink Beam Polarization		LINEAR	LINEAR	LINEAR	LINEAR	LINEAR
Downlink Satellite EIRP toward Earth Station	dBi	43.0	45.0	54.0	54.0	54.0
ADJACENT SATELLITE 1						
Hypothetical 168° E.L.						
Satellite 1 Orbital Location	deg	168	168	168	168	168
Uplink Power Density	dB(W/Hz)	-50.0	-50.0	-50.0	-50.0	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-22.0	-22.0	-22.0	-22.0
ADJACENT SATELLITE 2						
Eutelsat 172B						
Satellite 2 Orbital Location	deg	172	172	172	172	172
Uplink Power Density	dB(W/Hz)	-50.0	-50.0	-50.0	-50.0	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-22.0	-22.0	-22.0	-22.0
CARRIER INFORMATION						
Carrier ID		FWD Data Worst	RTN Data Worst	FWD Data Best	RTN Data Best	DigTV
Information Rate	kbps	3595	402	7990	938	61433
Modulation		BPSK	8APSK	16APSK	16APSK	8APSK
FEC Rate		0.36	0.52	0.60	0.69	0.46
Noise Bandwidth	kHz	10000.0	256.00	3333.3	341.3	45000.0
Minimum C/N, Clear Sky	dB	-3.0	5.4	8.8	10.1	4.5
UPLINK EARTH STATION						
Earth Station Diameter	meters	4.5	1.2	4.5	1.2	4.5
Earth Station Gain	dBi	54.6	43.1	54.6	43.1	54.0
Earth Station Latitude	deg	40.0	25.0	10.0	43.5	10.0
Earth Station Longitude	deg	-120.0	-120.0	125.0	143.0	125.0
Earth Station Elevation Angle	deg	6.5	9.5	37.2	33.0	37.2
DOWNLINK EARTH STATION						
Earth Station Diameter	meters	1.2	4.5	1.2	4.5	0.9
Earth Station G/T	dB/K	19.8	30.9	19.8	30.9	17.5
Earth Station Latitude	deg	25	40	43.5	10	43.5
Earth Station Longitude	deg	-120	-120	143	125	143
Earth Station Elevation Angle	deg	9.5	6.5	33.0	37.2	33.0
UPLINK PERFORMANCE						
Uplink Earth Station EIRP	dBW	70.7	51.1	58.4	47.6	69.0
Uplink Free Space Loss	dB	207.7	207.6	207.0	207.1	206.4
Uplink Atmospheric Attenuation	dB	0.3	0.3	0.3	0.3	0.3
Satellite G/T	dB/K	-1.0	-1.0	6.0	7.0	6.0
Carrier Noise Bandwidth	dB-Hz	70.0	54.1	65.2	55.3	76.5
Uplink C/N	dB	20.4	16.7	20.4	20.5	20.4
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier	dBW	33.2	15.7	39.5	29.6	50.1
Downlink Free Space Loss	dB	206.7	206.8	206.2	206.1	206.2
Downlink Atmospheric Attenuation	dB	0.2	0.2	0.2	0.2	0.2
Earth Station G/T	dB/K	19.8	30.9	19.8	30.9	17.5
Carrier Noise Bandwidth	dB-Hz	70.0	54.1	65.2	55.3	76.5
Downlink C/N	dB	4.7	14.1	16.3	27.4	13.3
COMPOSITE LINK PERFORMANCE						
C/N Uplink	dB	20.4	16.7	20.4	20.5	20.4
C/N Downlink	dB	4.7	14.1	16.3	27.4	13.3
C/I Uplink	dB	23.8	17.5	21.2	21.2	24.1
C/I Downlink	dB	18.5	14.7	18.0	18.4	17.6
C/I Uplink Adjacent Satellite 1	dB	29.5	25.8	22.8	21.8	22.1
C/I Downlink Adjacent Satellite 1	dB	4.9	14.9	16.8	28.4	14.2
C/I Uplink Adjacent Satellite 2	dB	29.5	25.9	22.7	21.8	22.0
C/I Downlink Adjacent Satellite 2	dB	5.0	14.9	16.7	28.3	14.2
C/(N+I) Composite	dB	0.0	7.4	9.6	13.1	7.8
Minimum Required C/N	dB	-3.0	5.4	8.8	10.1	4.5
Excess Clear Sky Link Margin	dB	3.0	2.0	0.8	3.0	3.3

UPLINK BEAM INFORMATION					
Uplink Beam Name		OAUL/OAUR	HUH2	OAUL/OAUR	HUH2
Uplink Frequency	GHz	28.2	14.2	28.2	14.2
Uplink Beam Polarization		CIRCULAR	LINEAR	CIRCULAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	13.2	12.2	13.2	12.2
DOWNLINK BEAM INFORMATION					
Downlink Beam Name		HDV4	OADR	HDV4	OADR
Downlink Frequency	GHz	12.7	19.0	12.7	19.0
Downlink Beam Polarization		LINEAR	CIRCULAR	LINEAR	CIRCULAR
Downlink Satellite EIRP toward Earth Station	dBi	53.9	45.3	53.9	45.3
ADJACENT SATELLITE 1					
Hypothetical 168° E.L.					
Satellite 1 Orbital Location	deg	168	168	168	168
Uplink Power Density	dB(W/Hz)	-56.5	-50.0	-56.5	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-15.6	-22.0	-15.6
ADJACENT SATELLITE 2					
Eutelsat 172B					
Satellite 2 Orbital Location	deg	172	172	172	172
Uplink Power Density	dB(W/Hz)	-56.5	-50.0	-56.5	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-15.6	-22.0	-15.6
CARRIER INFORMATION					
Carrier ID		HTS FWD	HTS RTN	HTS FWD	HTS RTN
Information Rate	kbps	19500	1672	48387	4703
Modulation		QPSK	QPSK	8APSK	8APSK
FEC Rate		0.33	0.28	0.54	0.52
Noise Bandwidth	kHz	30000.0	3000.0	30000.0	3000.0
Minimum C/N, Clear Sky	dB	0.1	-0.8	5.6	5.4
UPLINK EARTH STATION					
Earth Station Diameter	meters	9.2	0.5	9.2	1.2
Earth Station Gain	dBi	64.1	35.6	64.1	43.2
Earth Station Latitude	deg	21.3	45.0	21.3	45.0
Earth Station Longitude	deg	-157.9	-137.0	-157.9	-137.0
Earth Station Elevation Angle	deg	46.1	16.9	46.1	16.9
DOWNLINK EARTH STATION					
Earth Station Diameter	meters	0.5	9.2	1.2	9.2
Earth Station G/T	dB/K	11.5	38.6	19.1	38.6
Earth Station Latitude	deg	45	21.32	45	21.32
Earth Station Longitude	deg	-137	-157.87	-137	-157.87
Earth Station Elevation Angle	deg	16.9	46.1	16.9	46.1
UPLINK PERFORMANCE					
Uplink Earth Station EIRP	dBW	63.3	40.7	63.3	48.3
Uplink Free Space Loss	dB	212.9	207.5	212.9	207.5
Uplink Atmospheric Attenuation	dB	1.5	0.3	1.5	0.3
Satellite G/T	dB/K	13.2	12.2	13.2	12.2
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Uplink C/N	dB	15.9	8.9	15.9	16.5
DOWNLINK PERFORMANCE					
Downlink EIRP per Carrier	dBW	47.2	32.7	47.2	32.7
Downlink Free Space Loss	dB	206.6	209.5	206.6	209.5
Downlink Atmospheric Attenuation	dB	0.2	1.00	0.2	1.00
Earth Station G/T	dB/K	11.5	38.6	19.10	38.6
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Downlink C/N	dB	5.7	24.6	13.3	24.6
COMPOSITE LINK PERFORMANCE					
C/N Uplink	dB	15.9	8.9	15.9	16.5
C/N Downlink	dB	5.7	24.6	13.3	24.6
C/I Uplink	dB	25.7	12.4	25.7	12.4
C/I Downlink	dB	12.0	20.3	12.0	20.3
C/I Uplink Adjacent Satellite 1	dB	24.8	4.2	24.8	11.8
C/I Downlink Adjacent Satellite 1	dB	6.7	25.9	14.3	25.9
C/I Uplink Adjacent Satellite 2	dB	24.9	4.3	24.9	11.9
C/I Downlink Adjacent Satellite 2	dB	6.8	25.9	14.4	25.9
C/(N+I) Composite	dB	1.0	0.2	6.6	6.4
Minimum Required C/N	dB	0.1	-0.8	5.6	5.4
Excess Clear Sky Link Margin	dB	1.0	1.0	1.0	1.0

Hypothetical 170 East Satellite – Interferers RF/EIRP Densities Match Signal of Interest

UPLINK BEAM INFORMATION						
Uplink Beam Name		NUH2/NUV2	EUH2/EUV2	AUH2/AUV2	AUH2/AUV2	AUH3/AUV3
Uplink Frequency	GHz	14.1	14.1	14.1	14.1	13.1
Uplink Beam Polarization		LINEAR	LINEAR	LINEAR	LINEAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	-1.0	-1.0	6.0	7.0	6.0
DOWNLINK BEAM INFORMATION						
Downlink Beam Name		EDH1/EDV1	NDH2/NDV2	ADH1/ADV1	ADH1/ADV1	ADH2/ADV2
Downlink Frequency	GHz	12.7	12.7	12.7	12.7	12.7
Downlink Beam Polarization		LINEAR	LINEAR	LINEAR	LINEAR	LINEAR
Downlink Satellite EIRP toward Earth Station	dB	43.0	45.0	54.0	54.0	54.0
ADJACENT SATELLITE 1						
		Hypothetical 168° E.L.				
Satellite 1 Orbital Location	deg	168	168	168	168	168
Uplink Power Density	dB(W/Hz)	-53.8	-46.1	-61.4	-50.8	-61.5
Downlink EIRP Density	dB(W/Hz)	-36.8	-38.4	-25.7	-25.7	-26.4
ADJACENT SATELLITE 2						
		Eutelsat 172B				
Satellite 2 Orbital Location	deg	172	172	172	172	172
Uplink Power Density	dB(W/Hz)	-53.8	-46.1	-61.4	-50.8	-61.5
Downlink EIRP Density	dB(W/Hz)	-36.8	-38.4	-25.7	-25.7	-26.4
CARRIER INFORMATION						
Carrier ID		FWD Data Worst	RTN Data Worst	FWD Data Best	RTN Data Best	DigTV
Information Rate	kbps	7900	498	9493	972	80575
Modulation		QPSK	8APSK	16APSK	16APSK	8APSK
FEC Rate		0.40	0.65	0.71	0.71	0.60
Noise Bandwidth	kHz	10000.0	256.00	3333.3	341.3	45000.0
Minimum C/N, Clear Sky	dB	1.1	7.0	10.4	10.4	6.4
UPLINK EARTH STATION						
Earth Station Diameter	meters	4.5	1.2	4.5	1.2	4.5
Earth Station Gain	dB	54.6	43.1	54.6	43.1	54.0
Earth Station Latitude	deg	40.0	25.0	10.0	43.5	10.0
Earth Station Longitude	deg	-120.0	-120.0	125.0	143.0	125.0
Earth Station Elevation Angle	deg	6.5	9.5	37.2	33.0	37.2
DOWNLINK EARTH STATION						
Earth Station Diameter	meters	1.2	4.5	1.2	4.5	0.9
Earth Station G/T	dB/K	19.8	30.9	19.8	30.9	17.5
Earth Station Latitude	deg	25	40	43.5	10	43.5
Earth Station Longitude	deg	-120	-120	143	125	143
Earth Station Elevation Angle	deg	9.5	6.5	33.0	37.2	33.0
UPLINK PERFORMANCE						
Uplink Earth Station EIRP	dBW	70.7	51.1	58.4	47.6	69.0
Uplink Free Space Loss	dB	207.7	207.6	207.0	207.1	206.4
Uplink Atmospheric Attenuation	dB	0.3	0.3	0.3	0.3	0.3
Satellite G/T	dB/K	-1.0	-1.0	6.0	7.0	6.0
Carrier Noise Bandwidth	dB-Hz	70.0	54.1	65.2	55.3	76.5
Uplink C/N	dB	20.4	16.7	20.4	20.5	20.4
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier	dBW	33.2	15.7	39.5	29.6	50.1
Downlink Free Space Loss	dB	206.7	206.8	206.2	206.1	206.2
Downlink Atmospheric Attenuation	dB	0.2	0.2	0.2	0.2	0.2
Earth Station G/T	dB/K	19.8	30.9	19.8	30.9	17.5
Carrier Noise Bandwidth	dB-Hz	70.0	54.1	65.2	55.3	76.5
Downlink C/N	dB	4.7	14.1	16.3	27.4	13.3
COMPOSITE LINK PERFORMANCE						
C/N Uplink	dB	20.4	16.7	20.4	20.5	20.4
C/N Downlink	dB	4.7	14.1	16.3	27.4	13.3
C/I Uplink	dB	23.8	17.5	21.2	21.2	24.1
C/I Downlink	dB	18.5	14.7	18.0	18.4	17.6
C/I Uplink Adjacent Satellite 1	dB	33.3	21.9	34.2	22.6	33.6
C/I Downlink Adjacent Satellite 1	dB	19.7	31.3	20.5	32.1	18.7
C/I Uplink Adjacent Satellite 2	dB	33.4	21.9	34.1	22.6	33.5
C/I Downlink Adjacent Satellite 2	dB	19.8	31.3	20.5	32.1	18.6
C/(N+I) Composite	dB	4.1	9.0	11.3	13.5	9.7
Minimum Required C/N	dB	1.1	7.0	10.4	10.4	6.4
Excess Clear Sky Link Margin	dB	3.0	2.0	0.8	3.0	3.3

UPLINK BEAM INFORMATION					
Uplink Beam Name		OAUL/OAUR	HUH2	OAUL/OAUR	HUH2
Uplink Frequency	GHz	28.2	14.2	28.2	14.2
Uplink Beam Polarization		CIRCULAR	LINEAR	CIRCULAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	13.2	12.2	13.2	12.2
DOWNLINK BEAM INFORMATION					
Downlink Beam Name		HDV4	OADR	HDV4	OADR
Downlink Frequency	GHz	12.7	19.0	12.7	19.0
Downlink Beam Polarization		LINEAR	CIRCULAR	LINEAR	CIRCULAR
Downlink Satellite EIRP toward Earth Station	dB	53.9	45.3	53.9	45.3
ADJACENT SATELLITE 1					
Hypothetical 168° E.L.					
Satellite 1 Orbital Location	deg	168	168	168	168
Uplink Power Density	dB(W/Hz)	-75.6	-59.6	-75.6	-59.6
Downlink EIRP Density	dB(W/Hz)	-27.6	-32.1	-27.6	-32.1
ADJACENT SATELLITE 2					
Eutelsat 172B					
Satellite 2 Orbital Location	deg	172	172	172	172
Uplink Power Density	dB(W/Hz)	-75.6	-59.6	-75.6	-59.6
Downlink EIRP Density	dB(W/Hz)	-27.6	-32.1	-27.6	-32.1
CARRIER INFORMATION					
Carrier ID		HTS FWD	HTS RTN	HTS FWD	HTS RTN
Information Rate	kbps	28816	4134	58161	7108
Modulation		QPSK	QPSK	8APSK	16APSK
FEC Rate		0.48	0.69	0.65	0.59
Noise Bandwidth	kHz	30000.0	3000.0	30000.0	3000.0
Minimum C/N, Clear Sky	dB	2.3	4.5	7.0	8.7
UPLINK EARTH STATION					
Earth Station Diameter	meters	9.2	0.5	9.2	1.2
Earth Station Gain	dB	64.1	35.6	64.1	43.2
Earth Station Latitude	deg	21.3	45.0	21.3	45.0
Earth Station Longitude	deg	-157.9	-137.0	-157.9	-137.0
Earth Station Elevation Angle	deg	46.1	16.9	46.1	16.9
DOWNLINK EARTH STATION					
Earth Station Diameter	meters	0.5	9.2	1.2	9.2
Earth Station G/T	dB/K	11.5	38.6	19.1	38.6
Earth Station Latitude	deg	45	21.32	45	21.32
Earth Station Longitude	deg	-137	-157.87	-137	-157.87
Earth Station Elevation Angle	deg	16.9	46.1	16.9	46.1
UPLINK PERFORMANCE					
Uplink Earth Station EIRP	dBW	63.3	40.7	63.3	48.3
Uplink Free Space Loss	dB	212.9	207.5	212.9	207.5
Uplink Atmospheric Attenuation	dB	1.5	0.3	1.5	0.3
Satellite G/T	dB/K	13.2	12.2	13.2	12.2
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Uplink C/N	dB	15.9	8.9	15.9	16.5
DOWNLINK PERFORMANCE					
Downlink EIRP per Carrier	dBW	47.2	32.7	47.2	32.7
Downlink Free Space Loss	dB	206.6	209.5	206.6	209.5
Downlink Atmospheric Attenuation	dB	0.2	1.00	0.2	1.00
Earth Station G/T	dB/K	11.5	38.6	19.10	38.6
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Downlink C/N	dB	5.7	24.6	13.3	24.6
COMPOSITE LINK PERFORMANCE					
C/N Uplink	dB	15.9	8.9	15.9	16.5
C/N Downlink	dB	5.7	24.6	13.3	24.6
C/I Uplink	dB	25.7	12.4	25.7	12.4
C/I Downlink	dB	12.0	20.3	12.0	20.3
C/I Uplink Adjacent Satellite 1	dB	43.9	13.8	43.9	21.4
C/I Downlink Adjacent Satellite 1	dB	12.3	42.4	19.9	42.4
C/I Uplink Adjacent Satellite 2	dB	43.9	13.9	43.9	21.5
C/I Downlink Adjacent Satellite 2	dB	12.4	42.4	20.0	42.4
C/(N+I) Composite	dB	3.2	5.5	8.0	9.7
Minimum Required C/N	dB	2.3	4.5	7.0	8.7
Excess Clear Sky Link Margin	dB	1.0	1.0	1.0	1.0

EXHIBIT 3: ADJACENT SATELLITE (174° E. L.) LINK BUDGETS

Hypothetical 174 East Satellite - Maximum RF/EIRP Density Interference

UPLINK BEAM INFORMATION						
Uplink Beam Name		NUH2/NUV2	EUH2/EUV2	AUH2/AUV2	AUH2/AUV2	AUH3/AUV3
Uplink Frequency	GHz	14.1	14.1	14.1	14.1	13.1
Uplink Beam Polarization		LINEAR	LINEAR	LINEAR	LINEAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	-1.0	-1.0	6.0	7.0	6.0
DOWNLINK BEAM INFORMATION						
Downlink Beam Name		EDH1/EDV1	NDH2/NDV2	ADH1/ADV1	ADH1/ADV1	ADH2/ADV2
Downlink Frequency	GHz	12.7	12.7	12.7	12.7	12.7
Downlink Beam Polarization		LINEAR	LINEAR	LINEAR	LINEAR	LINEAR
Downlink Satellite EIRP toward Earth Station	dBi	43.0	45.0	54.0	54.0	54.0
ADJACENT SATELLITE 1						
		Eutelsat 172B				
Satellite 1 Orbital Location	deg	172	172	172	172	172
Uplink Power Density	dB(W/Hz)	-50.0	-50.0	-50.0	-50.0	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-22.0	-22.0	-22.0	-22.0
ADJACENT SATELLITE 2						
		Hypothetical 176° E.L.				
Satellite 2 Orbital Location	deg	176	176	176	176	176
Uplink Power Density	dB(W/Hz)	-50.0	-50.0	-50.0	-50.0	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-22.0	-22.0	-22.0	-22.0
CARRIER INFORMATION						
Carrier ID		FWD Data Worst	RTN Data Worst	FWD Data Best	RTN Data Best	DigTV
Information Rate	kbps	3595	402	7990	938	61433
Modulation		BPSK	8APSK	16APSK	16APSK	8APSK
FEC Rate		0.36	0.52	0.60	0.69	0.46
Noise Bandwidth	kHz	10000.0	256.00	3333.3	341.3	45000.0
Minimum C/N, Clear Sky	dB	-3.0	5.4	8.8	10.1	4.5
UPLINK EARTH STATION						
Earth Station Diameter	meters	4.5	1.2	4.5	1.2	4.5
Earth Station Gain	dBi	54.6	43.1	54.6	43.1	54.0
Earth Station Latitude	deg	40.0	25.0	10.0	43.5	10.0
Earth Station Longitude	deg	-120.0	-120.0	125.0	143.0	125.0
Earth Station Elevation Angle	deg	9.6	13.2	33.0	31.0	33.0
DOWNLINK EARTH STATION						
Earth Station Diameter	meters	1.2	4.5	1.2	4.5	0.9
Earth Station G/T	dB/K	19.8	30.9	19.8	30.9	17.5
Earth Station Latitude	deg	25	40	43.5	10	43.5
Earth Station Longitude	deg	-120	-120	143	125	143
Earth Station Elevation Angle	deg	13.2	9.6	31.0	33.0	31.0
UPLINK PERFORMANCE						
Uplink Earth Station EIRP	dBW	70.7	51.1	58.4	47.6	69.0
Uplink Free Space Loss	dB	207.6	207.5	207.1	207.1	206.5
Uplink Atmospheric Attenuation	dB	0.3	0.3	0.3	0.3	0.3
Satellite G/T	dB/K	-1.0	-1.0	6.0	7.0	6.0
Carrier Noise Bandwidth	dB-Hz	70.0	54.1	65.2	55.3	76.5
Uplink C/N	dB	20.4	16.8	20.4	20.4	20.3
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier	dBW	33.2	15.7	39.5	29.6	50.1
Downlink Free Space Loss	dB	206.6	206.7	206.3	206.2	206.3
Downlink Atmospheric Attenuation	dB	0.2	0.2	0.2	0.2	0.2
Earth Station G/T	dB/K	19.8	30.9	19.8	30.9	17.5
Carrier Noise Bandwidth	dB-Hz	70.0	54.1	65.2	55.3	76.5
Downlink C/N	dB	4.8	14.2	16.2	27.4	13.2
COMPOSITE LINK PERFORMANCE						
C/N Uplink	dB	20.4	16.8	20.4	20.4	20.3
C/N Downlink	dB	4.8	14.2	16.2	27.4	13.2
C/I Uplink	dB	23.8	17.5	21.2	21.2	24.1
C/I Downlink	dB	18.5	14.7	18.0	18.4	17.6
C/I Uplink Adjacent Satellite 1	dB	29.6	25.9	22.7	21.8	22.0
C/I Downlink Adjacent Satellite 1	dB	5.0	15.0	16.7	28.3	14.2
C/I Uplink Adjacent Satellite 2	dB	29.6	26.0	22.6	21.7	21.9
C/I Downlink Adjacent Satellite 2	dB	5.1	15.0	16.7	28.2	14.2
C/(N+I) Composite	dB	0.1	7.5	9.6	13.1	7.8
Minimum Required C/N	dB	-3.0	5.4	8.8	10.1	4.5
Excess Clear Sky Link Margin	dB	3.0	2.0	0.8	3.0	3.3

UPLINK BEAM INFORMATION					
Uplink Beam Name		OAUL/OAUR	HUH2	OAUL/OAUR	HUH2
Uplink Frequency	GHz	28.2	14.2	28.2	14.2
Uplink Beam Polarization		CIRCULAR	LINEAR	CIRCULAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	13.2	12.2	13.2	12.2
DOWNLINK BEAM INFORMATION					
Downlink Beam Name		HDV4	OADR	HDV4	OADR
Downlink Frequency	GHz	12.7	19.0	12.7	19.0
Downlink Beam Polarization		LINEAR	CIRCULAR	LINEAR	CIRCULAR
Downlink Satellite EIRP toward Earth Station	dB	53.9	45.3	53.9	45.3
ADJACENT SATELLITE 1					
Eutelsat 172B					
Satellite 1 Orbital Location	deg	172	172	172	172
Uplink Power Density	dB(W/Hz)	-56.5	-50.0	-56.5	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-15.6	-22.0	-15.6
ADJACENT SATELLITE 2					
Hypothetical 176° E.L.					
Satellite 2 Orbital Location	deg	176	176	176	176
Uplink Power Density	dB(W/Hz)	-56.5	-50.0	-56.5	-50.0
Downlink EIRP Density	dB(W/Hz)	-22.0	-15.6	-22.0	-15.6
CARRIER INFORMATION					
Carrier ID		HTS FWD	HTS RTN	HTS FWD	HTS RTN
Information Rate	kbps	19500	1672	48387	4703
Modulation		QPSK	QPSK	8APSK	8APSK
FEC Rate		0.33	0.28	0.54	0.52
Noise Bandwidth	kHz	30000.0	3000.0	30000.0	3000.0
Minimum C/N, Clear Sky	dB	0.1	-0.8	5.6	5.4
UPLINK EARTH STATION					
Earth Station Diameter	meters	9.2	0.5	9.2	1.2
Earth Station Gain	dB	64.1	35.6	64.1	43.2
Earth Station Latitude	deg	21.3	45.0	21.3	45.0
Earth Station Longitude	deg	-157.9	-137.0	-157.9	-137.0
Earth Station Elevation Angle	deg	49.6	19.4	49.6	19.4
DOWNLINK EARTH STATION					
Earth Station Diameter	meters	0.5	9.2	1.2	9.2
Earth Station G/T	dB/K	11.5	38.6	19.1	38.6
Earth Station Latitude	deg	45	21.32	45	21.32
Earth Station Longitude	deg	-137	-157.87	-137	-157.87
Earth Station Elevation Angle	deg	19.4	49.6	19.4	49.6
UPLINK PERFORMANCE					
Uplink Earth Station EIRP	dBW	63.3	40.7	63.3	48.3
Uplink Free Space Loss	dB	212.8	207.5	212.8	207.5
Uplink Atmospheric Attenuation	dB	1.5	0.3	1.5	0.3
Satellite G/T	dB/K	13.2	12.2	13.2	12.2
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Uplink C/N	dB	16.0	9.0	16.0	16.6
DOWNLINK PERFORMANCE					
Downlink EIRP per Carrier	dBW	47.2	32.7	47.2	32.7
Downlink Free Space Loss	dB	206.5	209.4	206.5	209.4
Downlink Atmospheric Attenuation	dB	0.2	1.00	0.2	1.00
Earth Station G/T	dB/K	11.5	38.6	19.10	38.6
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Downlink C/N	dB	5.8	24.7	13.4	24.7
COMPOSITE LINK PERFORMANCE					
C/N Uplink	dB	16.0	9.0	16.0	16.6
C/N Downlink	dB	5.8	24.7	13.4	24.7
C/I Uplink	dB	25.7	12.4	25.7	12.4
C/I Downlink	dB	12.0	20.3	12.0	20.3
C/I Uplink Adjacent Satellite 1	dB	24.9	4.3	24.9	11.9
C/I Downlink Adjacent Satellite 1	dB	6.8	26.0	14.4	26.0
C/I Uplink Adjacent Satellite 2	dB	24.9	4.3	24.9	11.9
C/I Downlink Adjacent Satellite 2	dB	6.8	26.0	14.4	26.0
C/(N+I) Composite	dB	1.1	0.3	6.7	6.5
Minimum Required C/N	dB	0.1	-0.8	5.6	5.4
Excess Clear Sky Link Margin	dB	1.0	1.0	1.0	1.0

Hypothetical 170 East Satellite – Interferers RF/EIRP Densities Match Signal of Interest

UPLINK BEAM INFORMATION						
Uplink Beam Name		NUH2/NUV2	EUH2/EUV2	AUH2/AUV2	AUH2/AUV2	AUH3/AUV3
Uplink Frequency	GHz	14.1	14.1	14.1	14.1	13.1
Uplink Beam Polarization		LINEAR	LINEAR	LINEAR	LINEAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	-1.0	-1.0	6.0	7.0	6.0
DOWNLINK BEAM INFORMATION						
Downlink Beam Name		EDH1/EDV1	NDH2/NDV2	ADH1/ADV1	ADH1/ADV1	ADH2/ADV2
Downlink Frequency	GHz	12.7	12.7	12.7	12.7	12.7
Downlink Beam Polarization		LINEAR	LINEAR	LINEAR	LINEAR	LINEAR
Downlink Satellite EIRP toward Earth Station	dB	43.0	45.0	54.0	54.0	54.0
ADJACENT SATELLITE 1						
		Eutelsat 172B				
Satellite 1 Orbital Location	deg	172	172	172	172	172
Uplink Power Density	dB(W/Hz)	-53.8	-46.1	-61.4	-50.8	-61.5
Downlink EIRP Density	dB(W/Hz)	-36.8	-38.4	-25.7	-25.7	-26.4
ADJACENT SATELLITE 2						
		Hypothetical 176° E.L.				
Satellite 2 Orbital Location	deg	176	176	176	176	176
Uplink Power Density	dB(W/Hz)	-53.8	-46.1	-61.4	-50.8	-61.5
Downlink EIRP Density	dB(W/Hz)	-36.8	-38.4	-25.7	-25.7	-26.4
CARRIER INFORMATION						
Carrier ID		FWD Data Worst	RTN Data Worst	FWD Data Best	RTN Data Best	DigTV
Information Rate	kbps	7900	498	9493	972	80575
Modulation		QPSK	8APSK	16APSK	16APSK	8APSK
FEC Rate		0.40	0.65	0.71	0.71	0.60
Noise Bandwidth	kHz	10000.0	256.00	3333.3	341.3	45000.0
Minimum C/N, Clear Sky	dB	1.1	7.0	10.4	10.4	6.4
UPLINK EARTH STATION						
Earth Station Diameter	meters	4.5	1.2	4.5	1.2	4.5
Earth Station Gain	dB	54.6	43.1	54.6	43.1	54.0
Earth Station Latitude	deg	40.0	25.0	10.0	43.5	10.0
Earth Station Longitude	deg	-120.0	-120.0	125.0	143.0	125.0
Earth Station Elevation Angle	deg	9.6	13.2	33.0	31.0	33.0
DOWNLINK EARTH STATION						
Earth Station Diameter	meters	1.2	4.5	1.2	4.5	0.9
Earth Station G/T	dB/K	19.8	30.9	19.8	30.9	17.5
Earth Station Latitude	deg	25	40	43.5	10	43.5
Earth Station Longitude	deg	-120	-120	143	125	143
Earth Station Elevation Angle	deg	13.2	9.6	31.0	33.0	31.0
UPLINK PERFORMANCE						
Uplink Earth Station EIRP	dBW	70.7	51.1	58.4	47.6	69.0
Uplink Free Space Loss	dB	207.6	207.5	207.1	207.1	206.5
Uplink Atmospheric Attenuation	dB	0.3	0.3	0.3	0.3	0.3
Satellite G/T	dB/K	-1.0	-1.0	6.0	7.0	6.0
Carrier Noise Bandwidth	dB-Hz	70.0	54.1	65.2	55.3	76.5
Uplink C/N	dB	20.4	16.8	20.4	20.4	20.3
DOWNLINK PERFORMANCE						
Downlink EIRP per Carrier	dBW	33.2	15.7	39.5	29.6	50.1
Downlink Free Space Loss	dB	206.6	206.7	206.3	206.2	206.3
Downlink Atmospheric Attenuation	dB	0.2	0.2	0.2	0.2	0.2
Earth Station G/T	dB/K	19.8	30.9	19.8	30.9	17.5
Carrier Noise Bandwidth	dB-Hz	70.0	54.1	65.2	55.3	76.5
Downlink C/N	dB	4.8	14.2	16.2	27.4	13.2
COMPOSITE LINK PERFORMANCE						
C/N Uplink	dB	20.4	16.8	20.4	20.4	20.3
C/N Downlink	dB	4.8	14.2	16.2	27.4	13.2
C/I Uplink	dB	23.8	17.5	21.2	21.2	24.1
C/I Downlink	dB	18.5	14.7	18.0	18.4	17.6
C/I Uplink Adjacent Satellite 1	dB	33.4	22.0	34.1	22.6	33.5
C/I Downlink Adjacent Satellite 1	dB	19.8	31.4	20.4	32.0	18.6
C/I Uplink Adjacent Satellite 2	dB	33.5	22.1	34.0	22.6	33.4
C/I Downlink Adjacent Satellite 2	dB	19.9	31.4	20.4	32.0	18.6
C/(N+I) Composite	dB	4.2	9.0	11.2	13.4	9.7
Minimum Required C/N	dB	1.1	7.0	10.4	10.4	6.4
Excess Clear Sky Link Margin	dB	3.0	2.0	0.8	3.0	3.3

UPLINK BEAM INFORMATION					
Uplink Beam Name		OAUL/OAUR	HUH2	OAUL/OAUR	HUH2
Uplink Frequency	GHz	28.2	14.2	28.2	14.2
Uplink Beam Polarization		CIRCULAR	LINEAR	CIRCULAR	LINEAR
Uplink Satellite G/T toward Earth Station	dB/K	13.2	12.2	13.2	12.2
DOWNLINK BEAM INFORMATION					
Downlink Beam Name		HDV4	OADR	HDV4	OADR
Downlink Frequency	GHz	12.7	19.0	12.7	19.0
Downlink Beam Polarization		LINEAR	CIRCULAR	LINEAR	CIRCULAR
Downlink Satellite EIRP toward Earth Station	dB	53.9	45.3	53.9	45.3
ADJACENT SATELLITE 1					
Eutelsat 172B					
Satellite 1 Orbital Location	deg	172	172	172	172
Uplink Power Density	dB(W/Hz)	-75.6	-59.6	-75.6	-59.6
Downlink EIRP Density	dB(W/Hz)	-27.6	-32.1	-27.6	-32.1
ADJACENT SATELLITE 2					
Hypothetical 176° E.L.					
Satellite 2 Orbital Location	deg	176	176	176	176
Uplink Power Density	dB(W/Hz)	-75.6	-59.6	-75.6	-59.6
Downlink EIRP Density	dB(W/Hz)	-27.6	-32.1	-27.6	-32.1
CARRIER INFORMATION					
Carrier ID		HTS FWD	HTS RTN	HTS FWD	HTS RTN
Information Rate	kbps	28816	4134	58161	7108
Modulation		QPSK	QPSK	8APSK	16APSK
FEC Rate		0.48	0.69	0.65	0.59
Noise Bandwidth	kHz	30000.0	3000.0	30000.0	3000.0
Minimum C/N, Clear Sky	dB	2.3	4.5	7.0	8.7
UPLINK EARTH STATION					
Earth Station Diameter	meters	9.2	0.5	9.2	1.2
Earth Station Gain	dB	64.1	35.6	64.1	43.2
Earth Station Latitude	deg	21.3	45.0	21.3	45.0
Earth Station Longitude	deg	-157.9	-137.0	-157.9	-137.0
Earth Station Elevation Angle	deg	49.6	19.4	49.6	19.4
DOWNLINK EARTH STATION					
Earth Station Diameter	meters	0.5	9.2	1.2	9.2
Earth Station G/T	dB/K	11.5	38.6	19.1	38.6
Earth Station Latitude	deg	45	21.32	45	21.32
Earth Station Longitude	deg	-137	-157.87	-137	-157.87
Earth Station Elevation Angle	deg	19.4	49.6	19.4	49.6
UPLINK PERFORMANCE					
Uplink Earth Station EIRP	dBW	63.3	40.7	63.3	48.3
Uplink Free Space Loss	dB	212.8	207.5	212.8	207.5
Uplink Atmospheric Attenuation	dB	1.5	0.3	1.5	0.3
Satellite G/T	dB/K	13.2	12.2	13.2	12.2
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Uplink C/N	dB	16.0	9.0	16.0	16.6
DOWNLINK PERFORMANCE					
Downlink EIRP per Carrier	dBW	47.2	32.7	47.2	32.7
Downlink Free Space Loss	dB	206.5	209.4	206.5	209.4
Downlink Atmospheric Attenuation	dB	0.2	1.00	0.2	1.00
Earth Station G/T	dB/K	11.5	38.6	19.10	38.6
Carrier Noise Bandwidth	dB-Hz	74.8	64.8	74.8	64.8
Downlink C/N	dB	5.8	24.7	13.4	24.7
COMPOSITE LINK PERFORMANCE					
C/N Uplink	dB	16.0	9.0	16.0	16.6
C/N Downlink	dB	5.8	24.7	13.4	24.7
C/I Uplink	dB	25.7	12.4	25.7	12.4
C/I Downlink	dB	12.0	20.3	12.0	20.3
C/I Uplink Adjacent Satellite 1	dB	44.0	13.9	44.0	21.5
C/I Downlink Adjacent Satellite 1	dB	12.4	42.5	20.0	42.5
C/I Uplink Adjacent Satellite 2	dB	44.0	14.0	44.0	21.6
C/I Downlink Adjacent Satellite 2	dB	12.4	42.5	20.0	42.5
C/(N+I) Composite	dB	3.3	5.6	8.0	9.7
Minimum Required C/N	dB	2.3	4.5	7.0	8.7
Excess Clear Sky Link Margin	dB	1.0	1.0	1.0	1.0

Exhibit 4: Service Areas

This document illustrates the service areas for the uplink and downlink beams in the accompanying Schedule S.

Uplink Beams

The C-band uplink service area includes the majority of the Pacific Ocean Region (POR) and is illustrated in Figure 1. It reflects the service area for beams CUH and CUV.

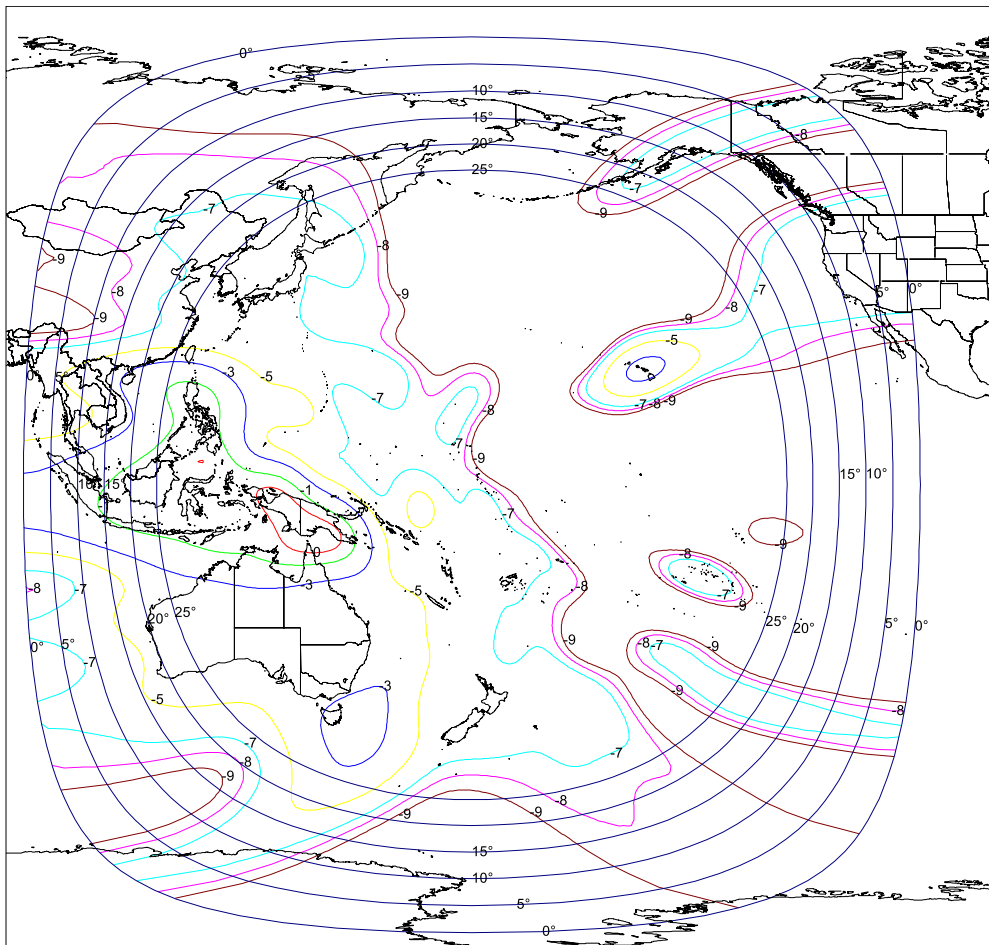


Figure 1 Provisional C-band POR uplink coverage of EUTELSAT 172B

The North-East Asia uplink service area includes Japan, the Korean Peninsula, Philippines and East China and is illustrated in Figure 2. It reflects the service area for beams AUH1, AUH2, AUH3, AUV1, AUV2 and AUV3.

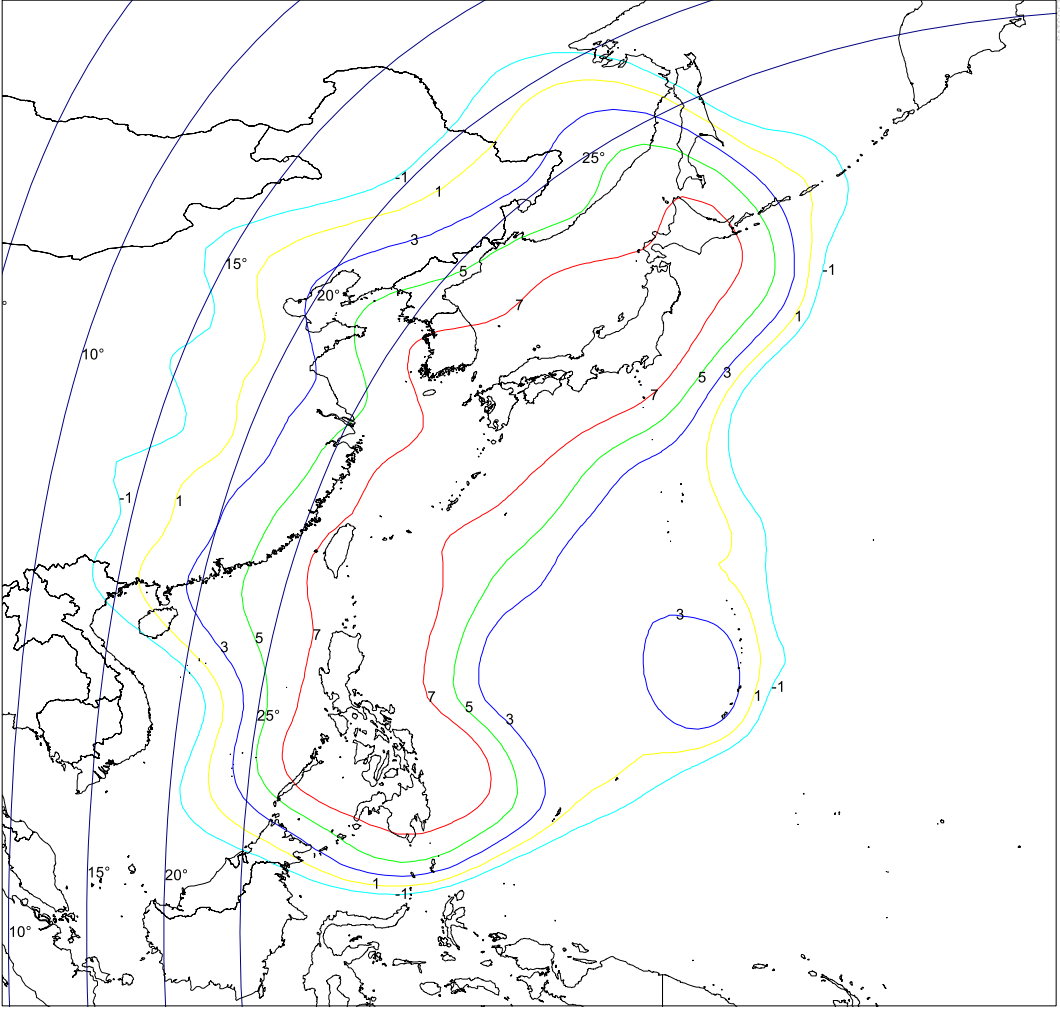


Figure 2 Provisional Ku-band North-East Asia uplink coverage of EUTELSAT 172B

The North Pacific uplink service area includes the northern part of the Pacific Ocean Region (POR) with coverage of eastern part of Asia and western part of North America and is illustrated in Figure 3. It reflects the service area for beams NUH1, NUH2, NUV1 and NUV2.

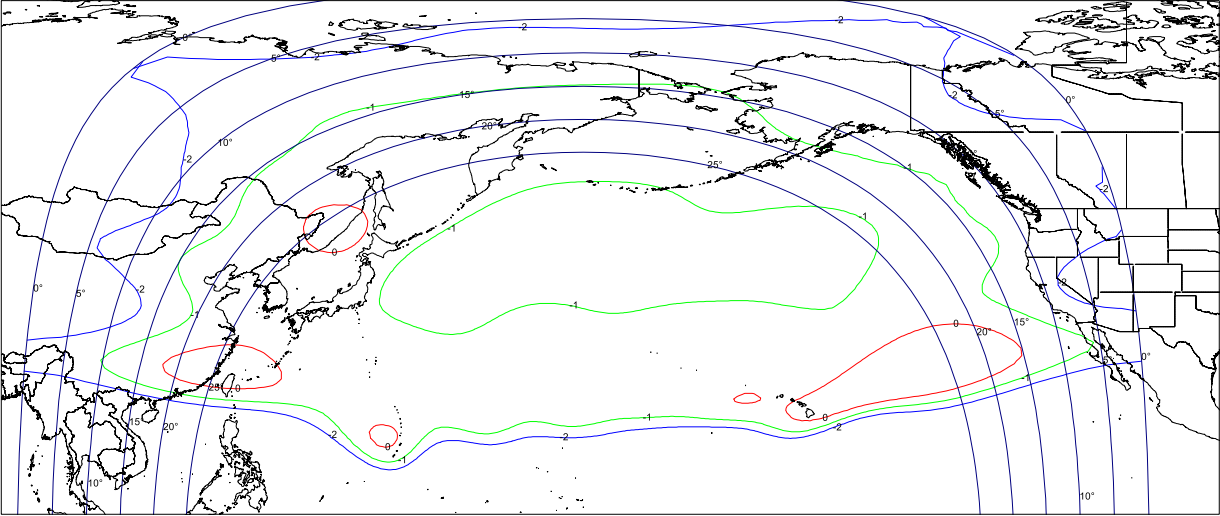


Figure 3 Provisional Ku-band North Pacific uplink coverage of EUTELSAT 172B

The South-East Pacific uplink service area includes the south-eastern part of the Pacific Ocean Region (POR) with coverage of Hawaii, French Polynesia and the Cook Islands and is illustrated in Figure 4. It reflects the service area for beams EUH1, EUH2, EUV1 and EUV2.

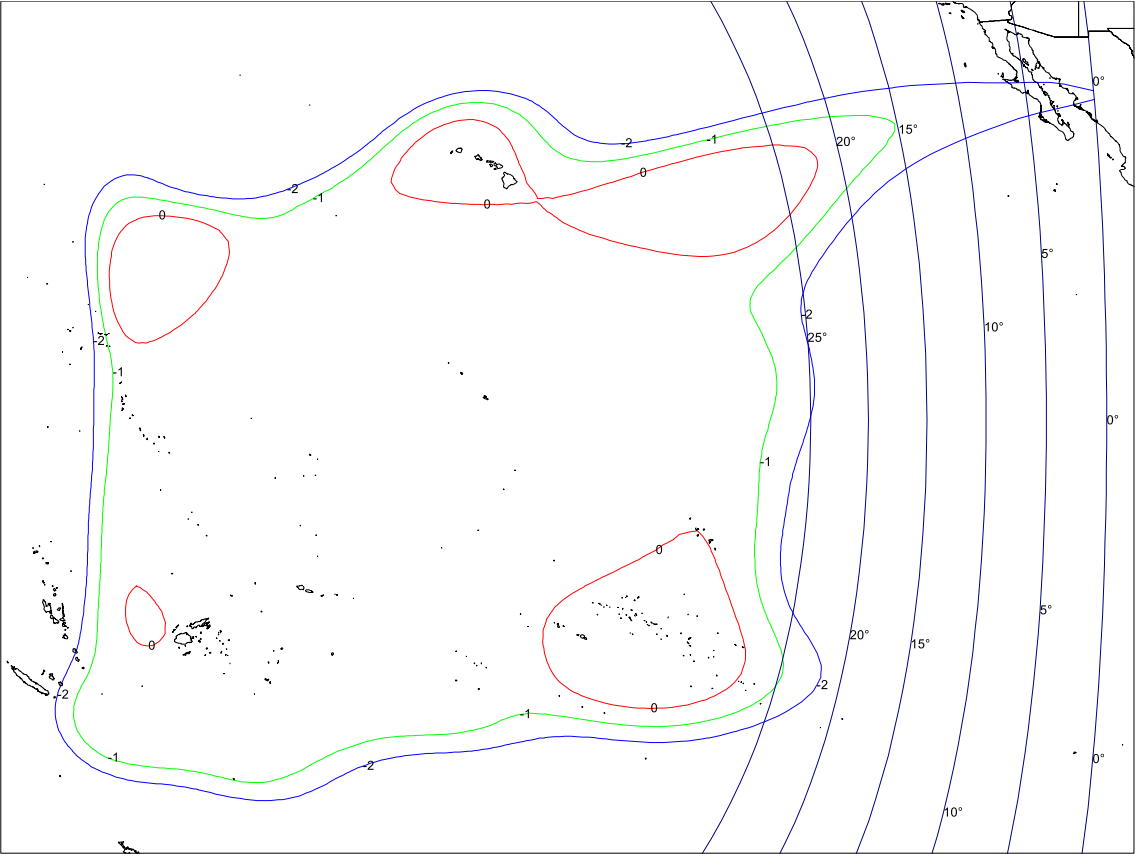


Figure 4 Provisional Ku-band South-East Pacific uplink coverage of EUTELSAT 172B

The South Pacific uplink service area includes the southern part of the Pacific Ocean Region (POR) with coverage of Australia and New Zealand and is illustrated in Figure 5. It reflects the service area for beams SUH1, SUH2, SUV1 and SUV2.

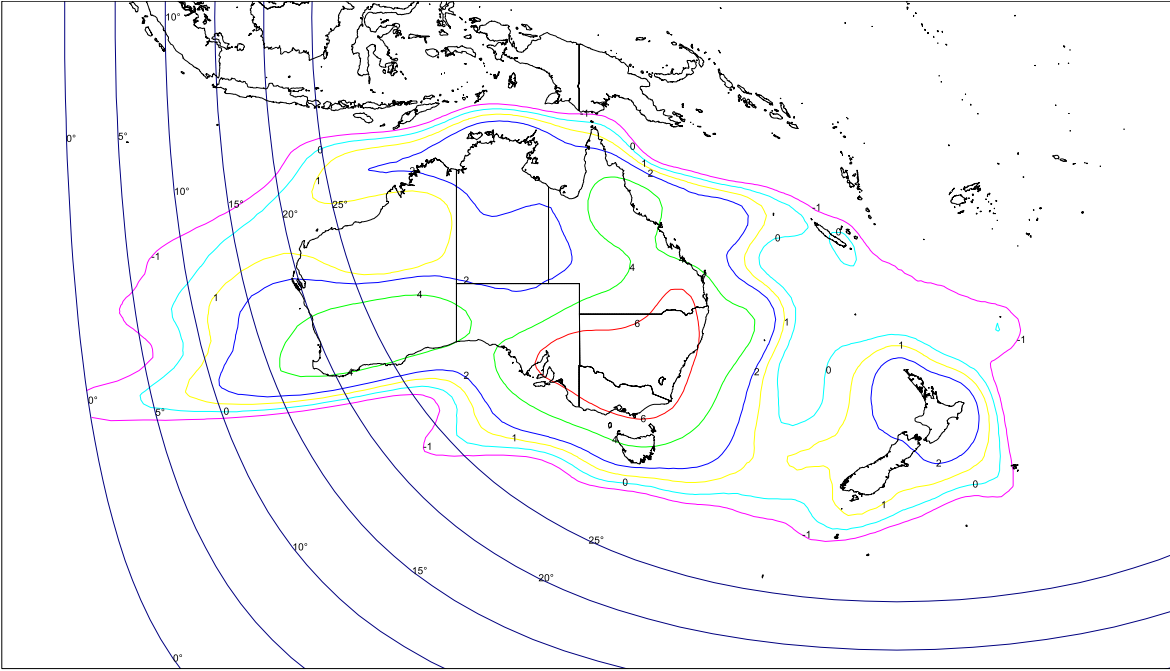


Figure 5 Provisional Ku-band South Pacific uplink coverage of EUTELSAT 172B

The South-West Pacific uplink service area includes the south-western part of the Pacific Ocean Region (POR) with coverage of South-East Asia, Malaysia, Philippines and Indonesia and is illustrated in Figure 6. It reflects the service area for beams WUH1, WUH2, WUV1 and WUV2.

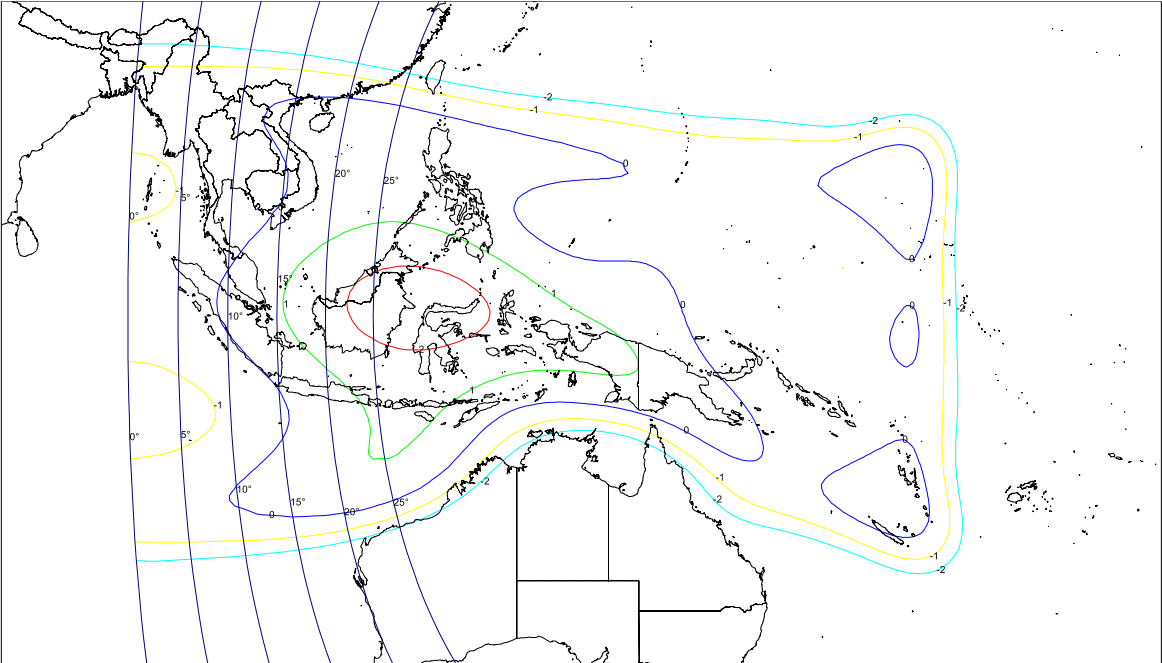


Figure 6 Provisional Ku-band South-West Pacific uplink coverage of EUTELSAT 172B

The North Pacific HTS uplink service area includes the northern part of the Pacific Ocean Region (POR) with coverage of eastern part of Asia and western part of North America and is illustrated in Figure 7. It reflects the service area for beam HUH2.

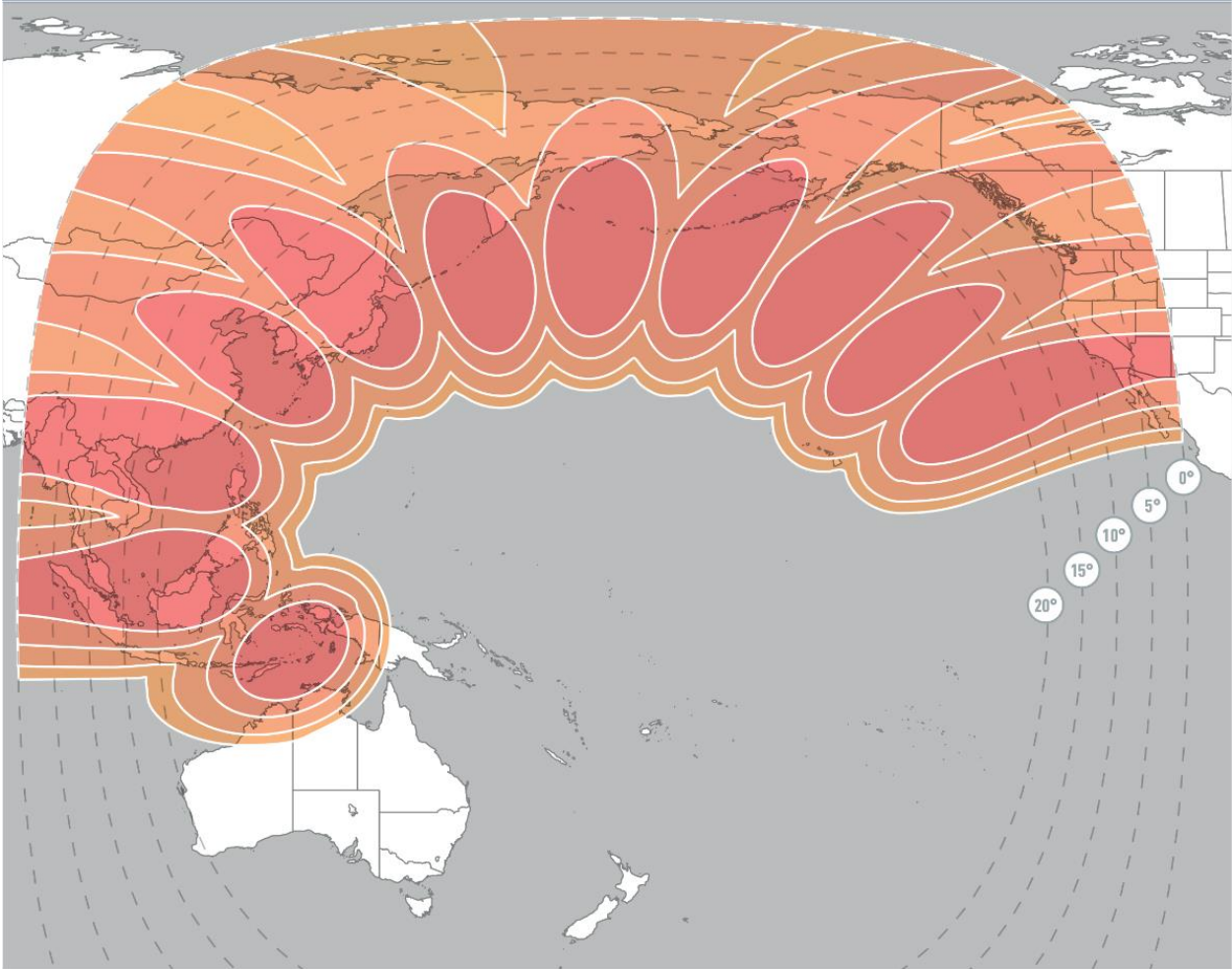


Figure 7 Provisional Ku-band North Pacific HTS uplink coverage of EUTELSAT 172B

The Gateway uplink service area includes the United States islands of Hawaii and is illustrated in Figure 8. It reflects the service area for beams OAUL and OAUR.

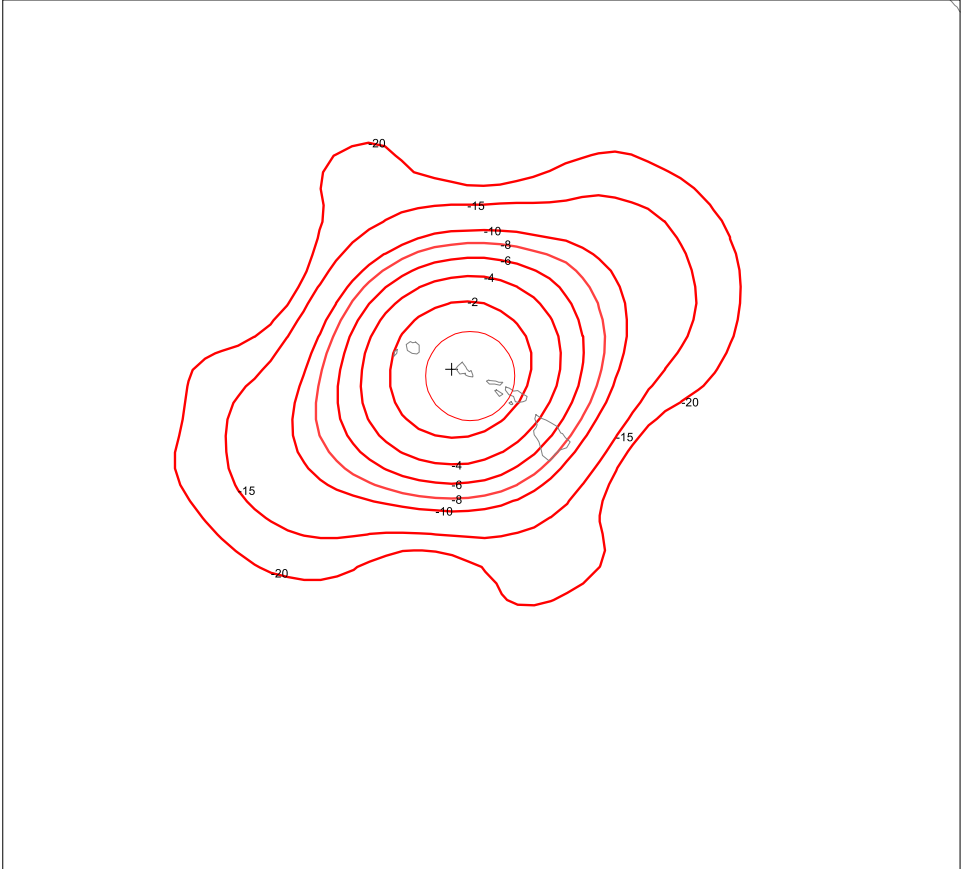


Figure 8 Provisional Ka-Band Gateway uplink beam coverage (Hawaii) of EUTELSAT 172B

Downlink Beams

The C-band downlink service area includes the majority of the Pacific Ocean Region (POR) and is illustrated in Figure 9. It reflects the service area for beams CDH and CDV.

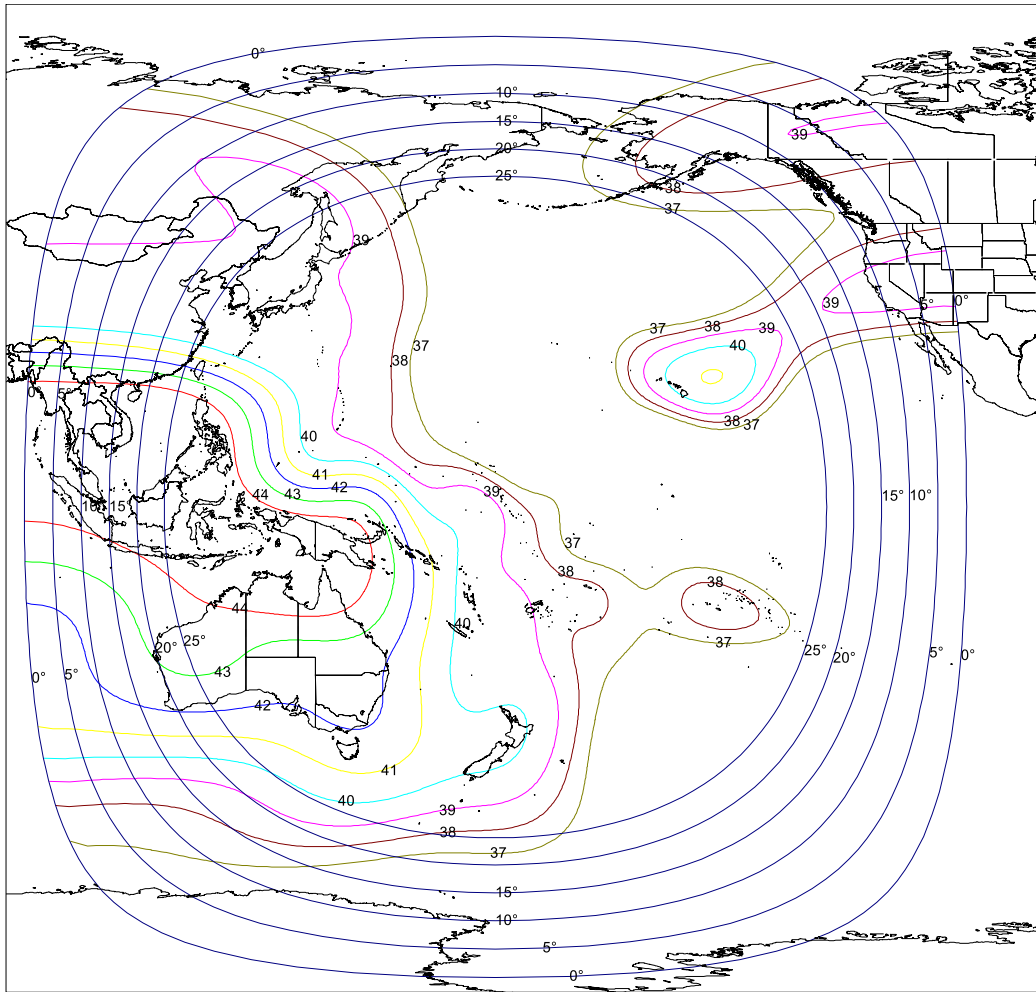


Figure 9 Provisional C-band POR downlink coverage of EUTELSAT 172B

The North-East Asia downlink service area includes Japan, the Korean Peninsula, Philippines and East China and is illustrated in Figure 10. It reflects the service area for beams ADH1, ADH2, ADH3, ADH4, ADV1, ADV2, ADV3 and ADV4.

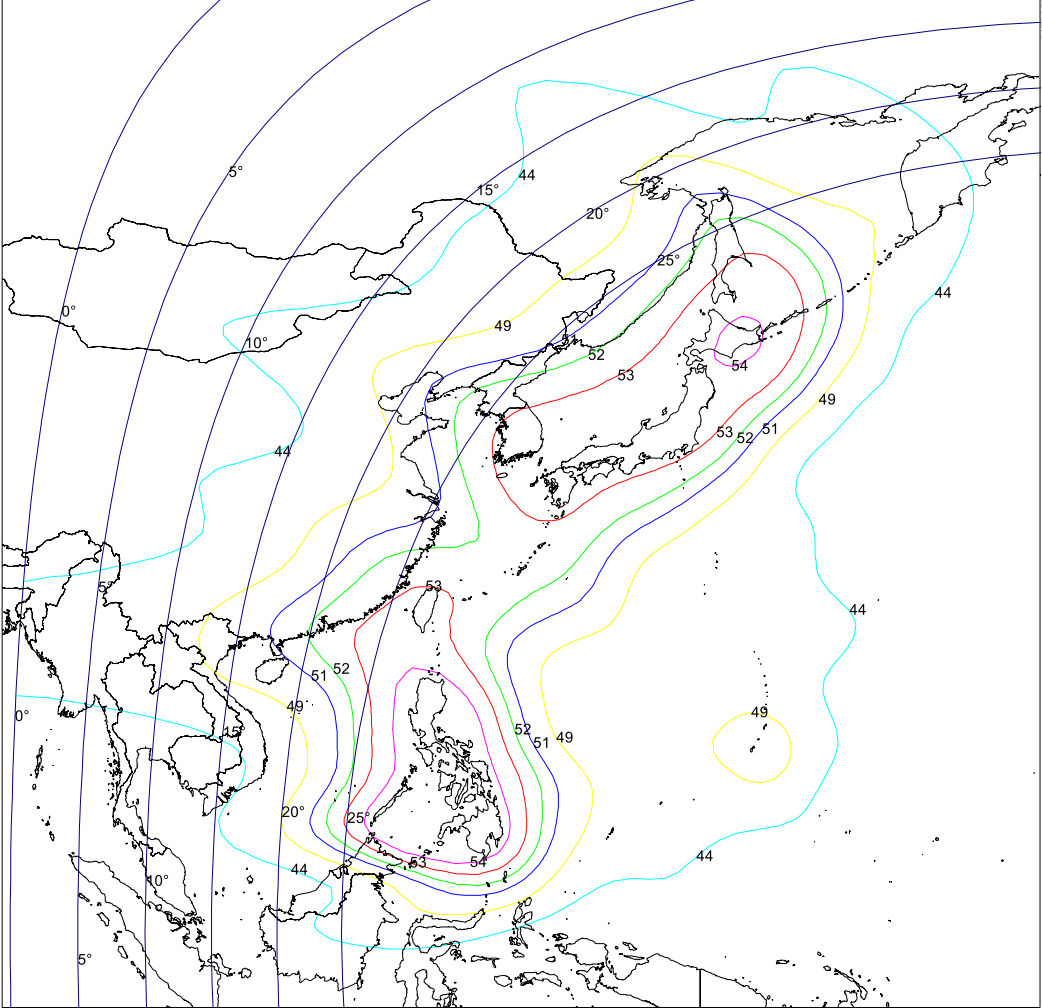


Figure 10 Provisional Ku-band North-East Asia downlink coverage of EUTELSAT 172B

The North Pacific downlink service area includes the northern part of the Pacific Ocean Region (POR) with coverage of eastern part of Asia and western part of North America and is illustrated in Figure 11. It reflects the service area for beams NDH1, NDH2, NDH4, NDV1, NDV2 and NDV4.

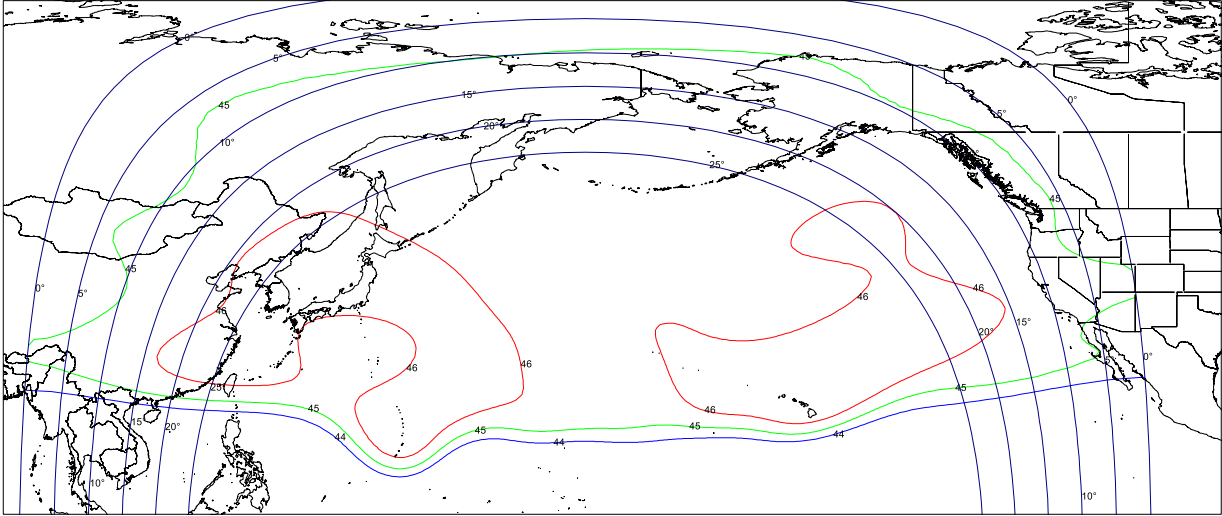


Figure 11 Provisional Ku-band North Pacific downlink coverage of EUTELSAT 172B

The South-East Pacific downlink service area includes the south-eastern part of the Pacific Ocean Region (POR) with coverage of Hawaii, French Polynesia and the Cook Islands and is illustrated in Figure 12. It reflects the service area for beams EDH1, EDH2, EDH4, EDV1, EDV2 and EDV4.

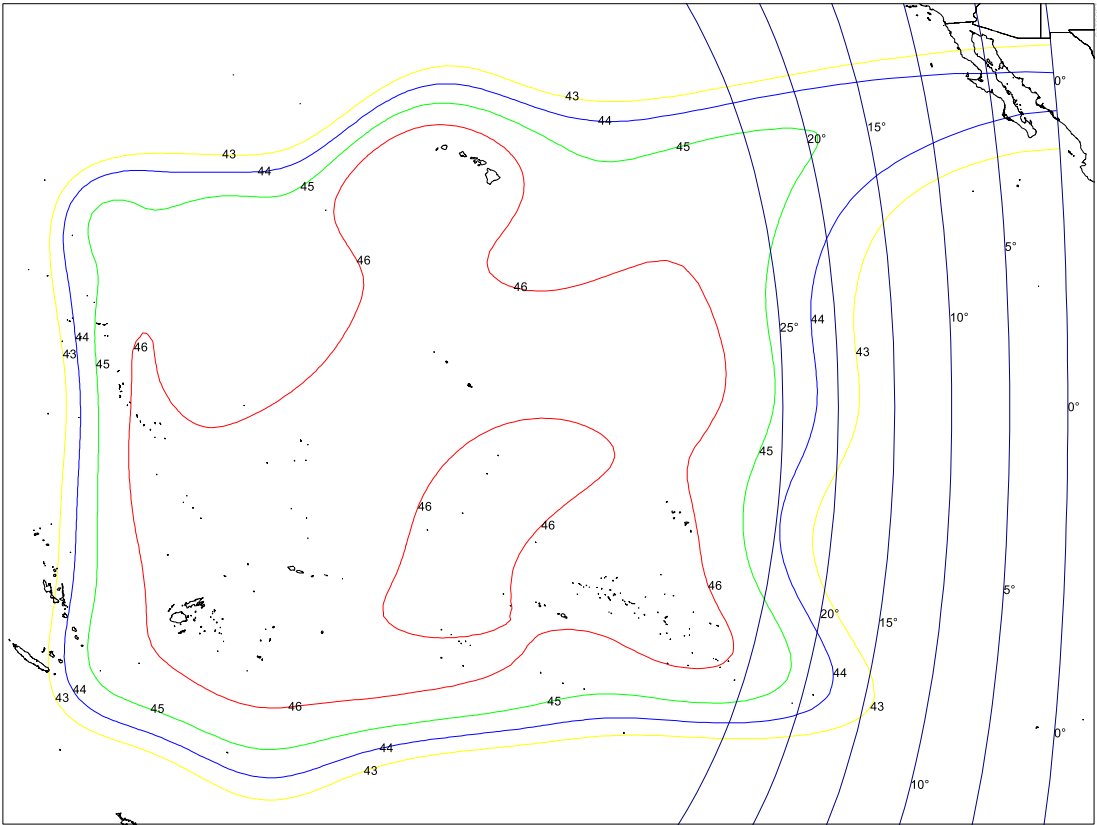


Figure 12 Provisional Ku-band South-East Pacific downlink coverage of EUTELSAT 172B

The South Pacific downlink service area includes the southern part of the Pacific Ocean Region (POR) with coverage of Australia and New Zealand and is illustrated in Figure 13. It reflects the service area for beams SDH1, SDH2, SDH4, SDV1, SDV2 and SDV4.

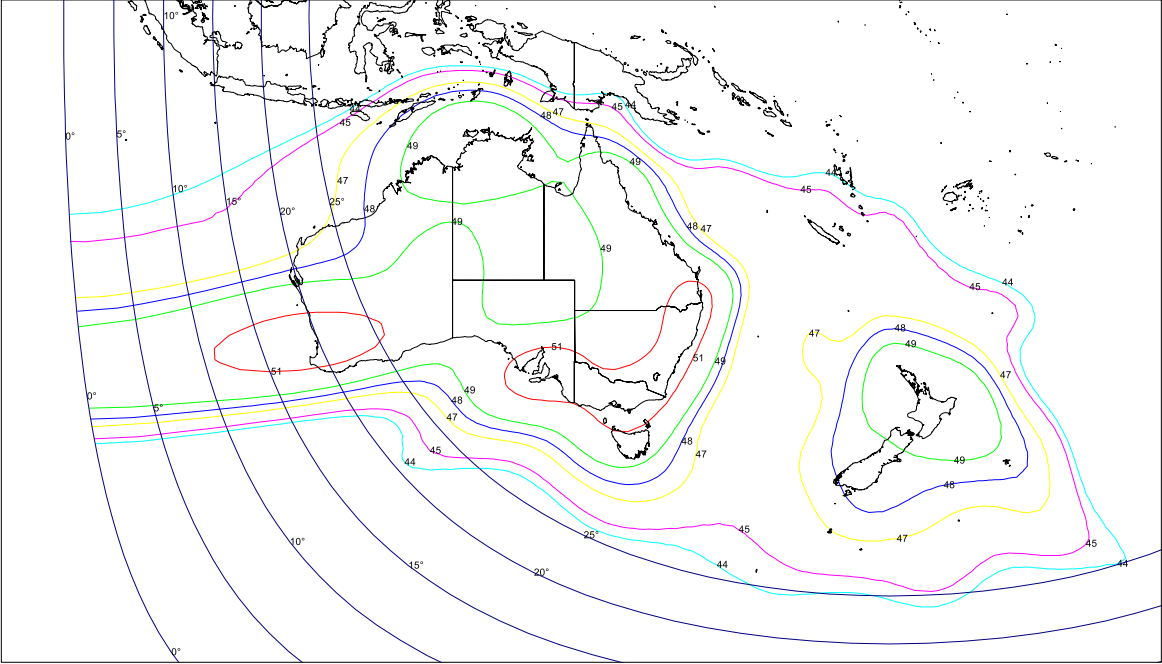


Figure 13 Provisional Ku-band South Pacific downlink coverage of EUTELSAT 172B

The South-West Pacific downlink service area includes the south-western part of the Pacific Ocean Region (POR) with coverage of South-East Asia, Malaysia, Philippines and Indonesia and is illustrated in Figure 14. It reflects the service area for beams WDH1, WDH2, WDH4, WDV1, WDV2 and WDV4.

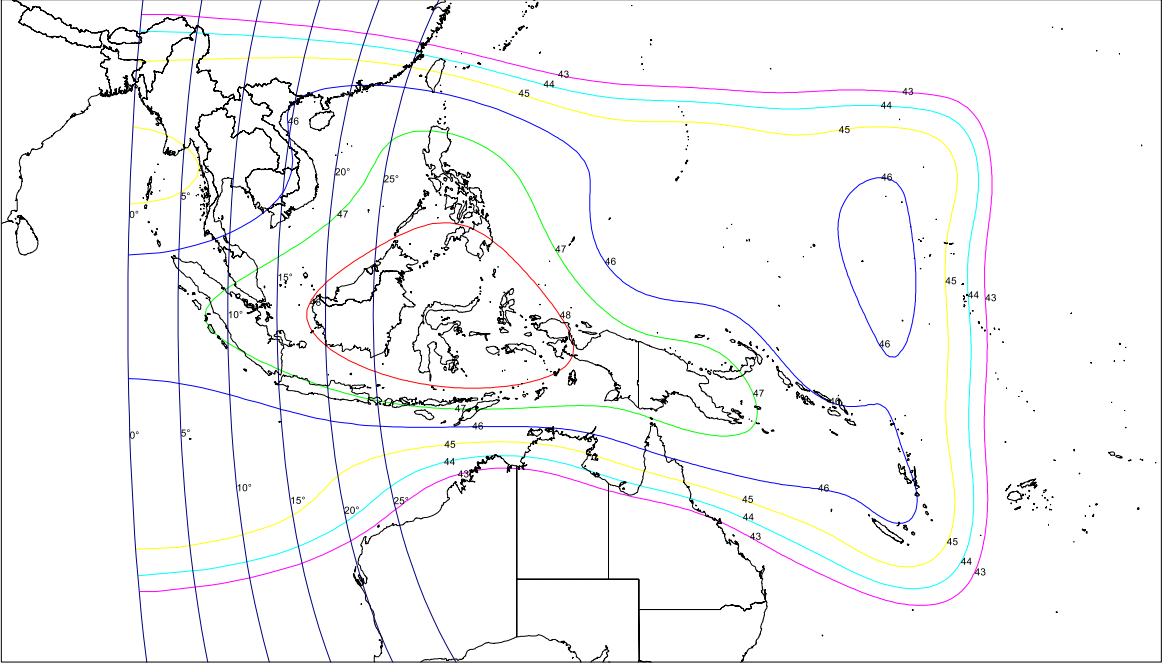


Figure 14 Provisional Ku-band South-West Pacific downlink coverage of EUTELSAT 172B

The North Pacific HTS downlink service area includes the northern part of the Pacific Ocean Region (POR) with coverage of eastern part of Asia and western part of North America and is illustrated in Figure 15. It reflects the service area for beam HDV4.

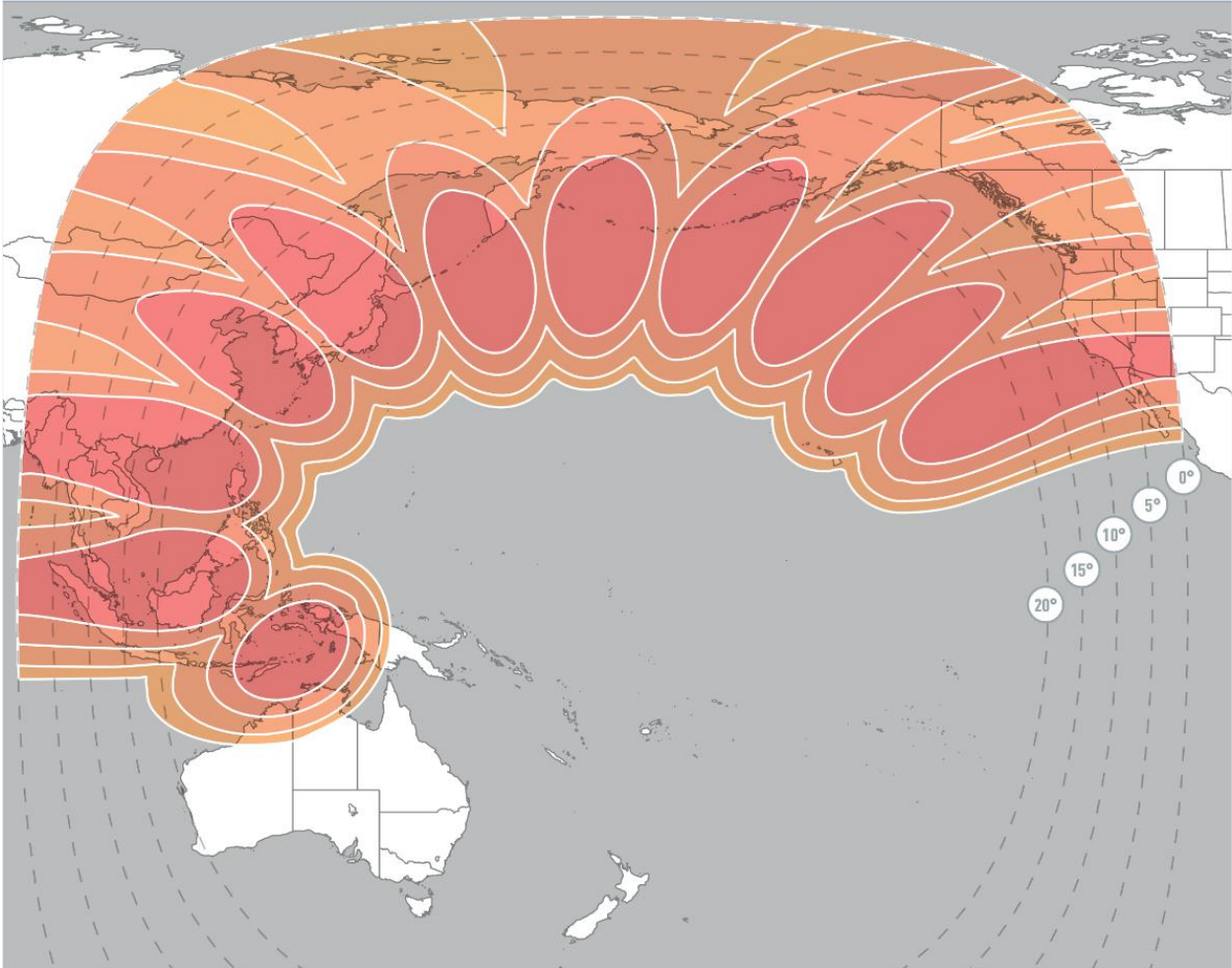


Figure 15 Provisional Ku-band North Pacific HTS downlink coverage of EUTELSAT 172B

The Gateway downlink service area includes the United States islands of Hawaii and is illustrated in Figure 16. It reflects the service area for beam OADR.

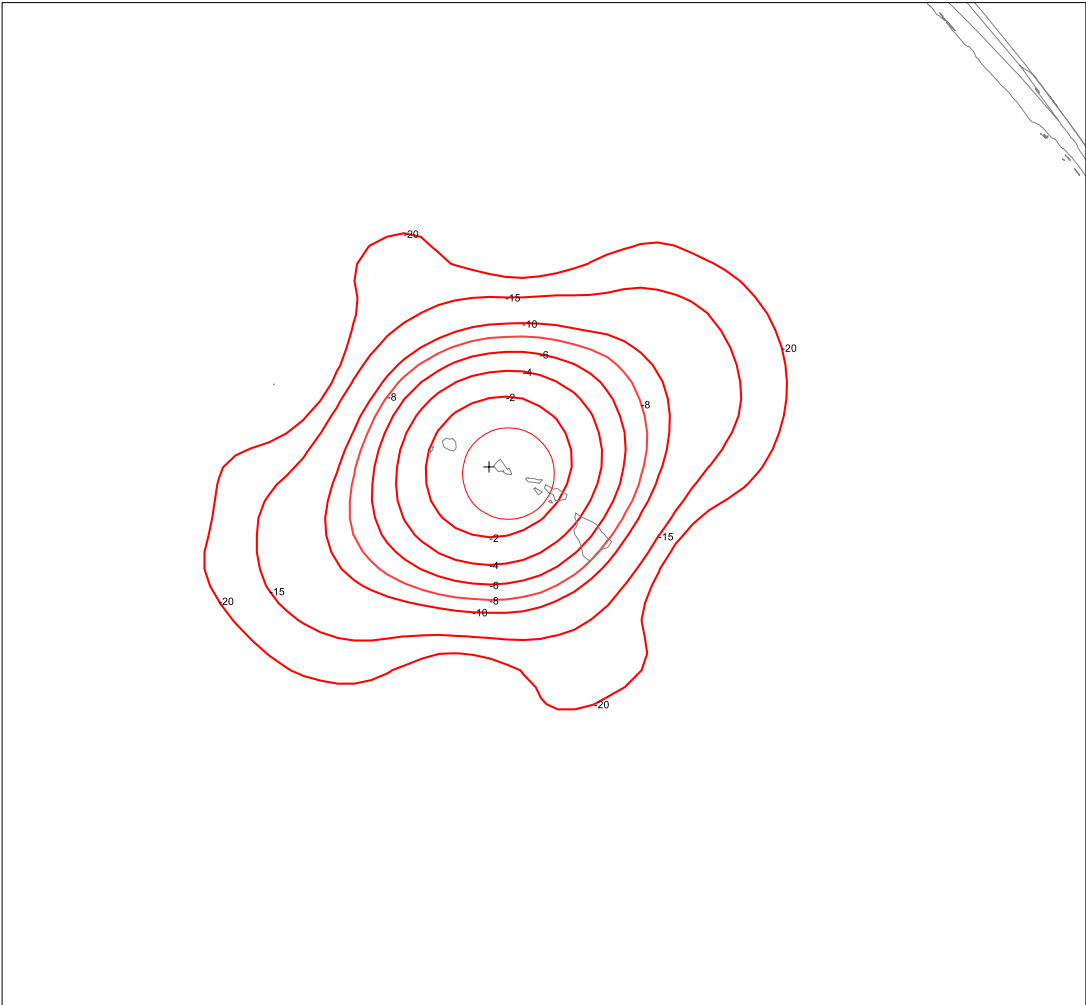


Figure 16 Provisional Ka-Band Gateway downlink beam coverage (Hawaii) of EUTELSAT 172B

Exhibit 5: Beam Pointing Locations for the Ku-Band HTS Uplink Beam (HUH2) and Downlink Beam (HDV4)

The EUTELSAT 172B HTS payload uses a total of 11 identical beams in both the uplink and downlink directions. In accordance with 25.114(c)(4)(vii), an overall area map of the eleven beam is illustrated in Figure 7 and a table describing the maximum antenna gain points in latitude and longitude is shown in Table 8.

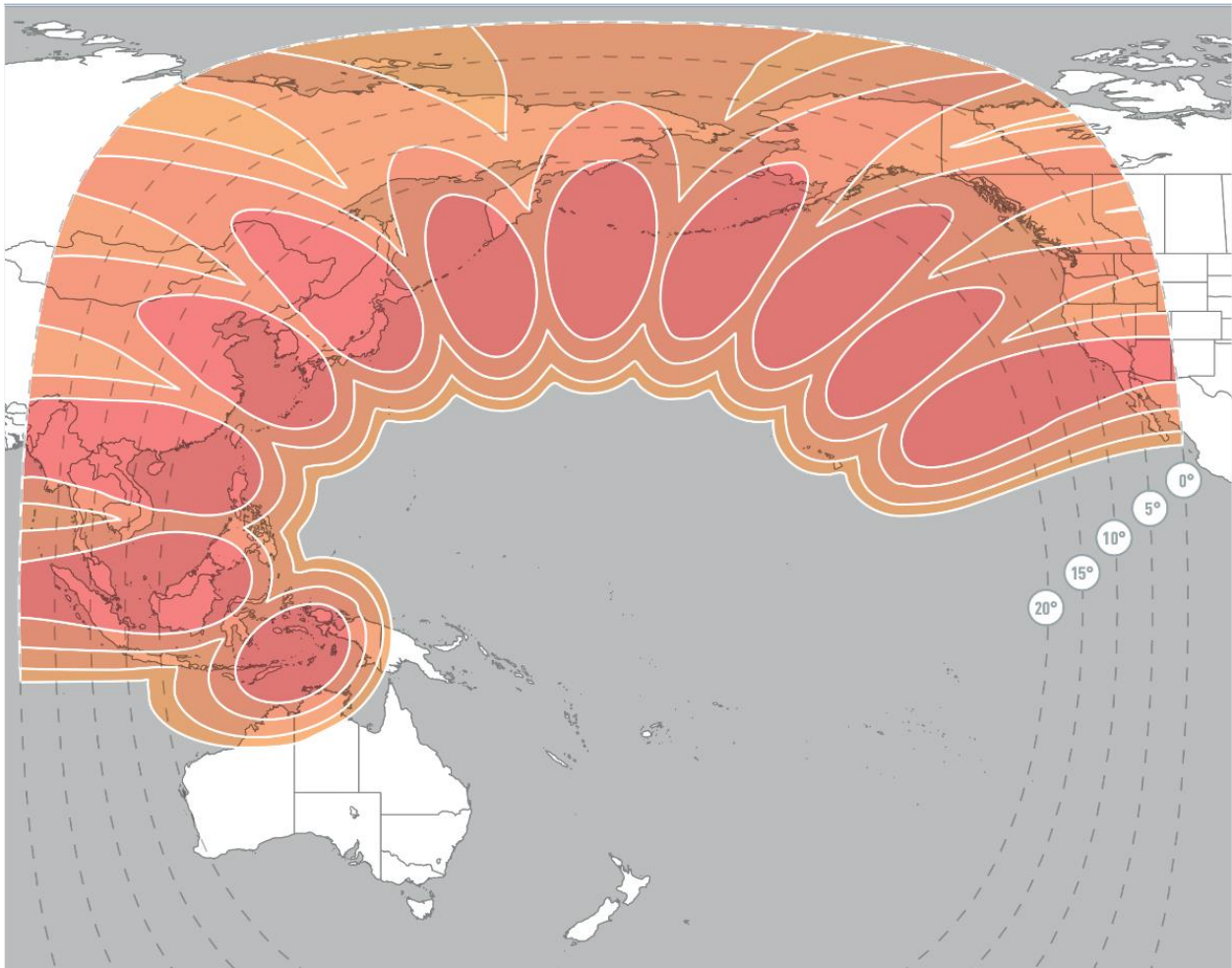


Figure 17 Provisional Ku-band North Pacific HTS uplink/down coverage of EUTELSAT 172B

Table 8 HTS Ku-band Uplink/Downlink Beam Peak Gain Locations

HTS Spot Beam Number	long (°E)	lat (°N)
Spot 1	130.5°	-6.9°
Spot 2	113.2°	2.9°
Spot 3	113.5°	19.7°
Spot 4	125.4°	32.6°
Spot 5	139.2 °	41.2°
Spot 6	155.8 °	43.9°
Spot 7	170.7 °	46.6°
Spot 8	-172.6°	46.6°
Spot 9	-158.2°	42.0°
Spot 10	-148.3°	33.8°
Spot 11	-135.6°	26.7°


The HTS beams are formed with two reflectors that are fed from 11 transmit/receive feeds (five feeds using one reflector and six feeds using the second reflector), are 2°x3° in size and are rotated 15° clockwise with respect to boresight vector. Differences in coverage area/shape are a result of differences in projection of the beams on the surface of the Earth.


This information is applicable to beam HUH2 on the uplink and HDV4 on the downlink. The GIMS database, attached to the Schedule S, provides antenna patterns for a representative uplink and downlink beam.

Eutelsat 172B Space Debris Mitigation Plan (prepared for the Federal Communications Commission)

ISSUE/REVISION: Issue 1, Rev. 1

ISSUE DATE: 31 May 2017

<i>Prepared by:</i>	<i>Position</i>	<i>Signature</i>	<i>Date</i>
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L.R. Pattinson	Director of Satellite Operations		01/06/2017

CHANGE RECORD

<i>Date</i>	<i>Issue/rev</i>	<i>Pages affected</i>	<i>Description</i>
11/05/2017	1/0	All	First issue.
31/05/2017	1/1	4-8	Update version number of the AD.1. Incorporate editorial changes and add details about propellant tanks and collocation strategy with E172A.

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1. Introduction

This document describes the space debris mitigation plan for **Eutelsat 172B** (“**E172B**”), a French-licensed satellite owned by Eutelsat Asia Pte Ltd (referred to herein, together with its ultimate parent, Eutelsat Communications S.A., and intermediate entities, as “Eutelsat”).

E172B was manufactured and supplied by Airbus Defense and Space based on the Airbus Eurostar 3000 EOR (Electric Orbit Raising) bus platform. The satellite is 3-axis stabilized and uses electrical propulsion for initial orbit raising and on-station control.

E172B is scheduled for launch in early June 2017 and the end of its operational life is not expected to be before 2032.

2. Related documents

2.1. Applicable Documents

1. EUTELSAT Space Debris Mitigation Plan. Issue 2.0. EUT_CTL_SAT_QMS_PLN_00021, 25 April 2017.
2. FCC. Orbital Debris Mitigation Standard Practices. FCC 04-130. June 21, 2004.

2.2. Reference Documents

1. European Code of Conduct for Space Debris Mitigation. Issue 1.0. 28 June 2004.
2. IADC Space Debris Mitigation Guidelines. IADC-02-01. Revision 1. September 2007.
3. Space Product Assurance. Safety. ECSS-Q-40A. 19 April 1996.
4. NASA Safety Standard. Guidelines and Assessment Procedures for limiting Orbital Debris. NSS 1740.14. Aug 1995.
5. ITU Environment Protection of the Geostationary Orbit. S.1003. 1993.
6. UNCOPUOS. Technical Report on Space Debris. 1999.

3. Eutelsat 172B operations

The E172B satellite strictly complies with requirements in the French Space Operations Act, as well as prevailing international best practices and standards, to minimize space debris.

Eutelsat operational procedures and the E172B satellite design limit the amount of debris released during normal operations and the probability of the space station becoming a source of debris by collisions with small debris or meteoroids that could cause loss of control and prevent post-mission disposal.

Eutelsat has assessed the amount of debris released in a planned manner and no intentional debris will be released during normal operations of the E172B satellite. A safe operational configuration of the satellite is ensured thanks to the hardware design and operational procedures.

Eutelsat minimizes the probability of the satellite becoming a source of debris by collisions with large debris or other operational satellites. Eutelsat assessed and determined that, other than the E172A satellite located at 172.0°E, there are no other satellites located at or sufficiently near E172B's planned orbital location that might result in overlap of satellite orbit control windows.

The licensee of the E172A satellite, ES 172 LLC, is a wholly owned subsidiary of Eutelsat. For the period when both the E172A and E172B satellites are co-located at the 172.0°E orbit location, Eutelsat will coordinate their flight profiles internally to maintain adequate separation distances and ensure there is no possibility of collision.¹

E172B will be controlled within its orbit control window (172.0°E +/-0.1°) by standard routine periodic orbit correction maneuvers. In case of potential drift outside this window, correction maneuvers will be implemented to maintain satellite location within the window.

Eutelsat has assessed the probability of accidental explosions during and after completion of mission operations. Thanks to design safety margins and enough safety barriers, the probability of occurrence of accidental explosion of the E172B satellite is negligible.

The satellite design, which includes electric propulsion for on-station control, is such that high levels of thruster activity and orbit perturbation do not occur during normal operations.

4. Eutelsat 172B End-of-Life Disposal

According to French Space Operations Act, IADC guidelines and best practices and standards, any geostationary satellite at end-of-life ("EOL") shall be disposed to an orbit that ensures that the satellite will not re-enter the geostationary orbit ("GEO") protected region (GEO height +/- 200 km) in the long term. The post-mission disposal activities have been planned as follows:

1. The orbit of the satellite will be raised by 300 km to ensure that the satellite will not re-enter the GEO protected region. 1.8 kg of Xenon have been allocated and reserved with a confidence level of 99.7% to carry out the post-mission disposal maneuvers. During the satellite lifetime, Eutelsat will routinely monitor the propellant remaining in the propellant tanks. The FCC will be informed of any significant change to the above quantity of propellant.

The minimum perigee height to avoid re-entering into the GEO protected region can be computed using the IADC formula applied to this satellite:

$$\Delta H \text{ (km)} = 235 + 1000 \cdot (A/m)_{\text{eff}} = 256 \text{ km}$$

where the final term is the effective area/mass ratio of the satellite. Therefore, the planned 300 km above GEO height is sufficient to satisfy the 256 km requirement.

2. The satellite tracking, telemetry and control operations are planned to avoid interference and coordinated with potentially affected satellite networks.

¹ Eutelsat will apply a combined eccentricity and inclination vector separation method to ensure sufficient separation between the two satellites.

3. As part of the EOL activities, E172B energy sources will be rendered inactive such that debris generation will not result from the conversion or dissipation of energy sources onboard the satellite. For E172B, this involves the following:
- Discharge the batteries during EOL operations and isolate them from the solar arrays to prevent further electrical energy storage.
 - Switch off the momentum wheels.
 - Deplete and eventually vent the propellant tanks, which allows depressurizing during passivation operations and results in only negligible residuals remaining in the tanks. In addition, the tanks are “leak before burst” designed. Therefore, the risk of break-up is negligible.
 - All pyrotechnic systems are fired at initial stage of life. Those systems do not generate any debris.

5. Notifications

EUTELSAT undertakes to provide the relevant bodies as required (UNCOPUOS, FCC, ITU, ANFR, etc.) with all appropriate notifications as required by law or regulations including but not limited to those concerning initial commencement of service, location, relocation, inclined orbit operations and EOL operations.