Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of Application of	)	
	)	
SES Americom, Inc.	)	File No. SAT-RPL-__________
	)	
For Authority to Operate the SES-3 Replacement Satellite at 103° W.L.	)	

Expedited Action Requested

APPLICATION OF SES AMERICOM, INC.

SES Americom, Inc. ("SES Americom," doing business as "SES"), hereby applies for authority under the Communications Act of 1934, as amended, and the Federal Communications Commission's regulations thereunder, to operate the in-orbit SES-3 satellite in the conventional C- and Ku-band frequencies[1] at 103° W.L. SES seeks any necessary waiver of Section 25.113(g) of the Commission's rules in connection with this application. SES-3 will replace the AMC-1 spacecraft, which is currently operating in these bands at 103° W.L.,[2] and SES requests expedited Commission action to facilitate service continuity at that location.

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[1] The "conventional C-band" refers to the 3700-4200 MHz and 5925-6425 MHz frequencies. The "conventional Ku-band" refers to the 11.7-12.2 GHz and 14.0-14.5 GHz frequencies.

In addition to the C- and Ku-band payloads, SES-3 has a 17/24 GHz Broadcasting Satellite Service ("BSS") payload that has been licensed by Canada to Ciel Satellite Limited Partnership ("Ciel"), an affiliate of SES Americom. *See* Industry Canada Radio Licence, Account Number 07-150006068, effective Sept. 21, 2012; Letter of Suzanne Lambert, Director, Space Services Operations, Industry Canada, to Bernie Haughian, Managing Director, Ciel Satellite Limited Partnership dated Sept. 21, 2012 (approving Ciel's plan to use an interim 17 GHz BSS satellite at 103° W.L.). The 17/24 GHz BSS payload is designated Ciel-6i. SES is not seeking U.S. market access for this payload, but a detailed technical description of the payload is provided herein for informational purposes.

[2] Because SES proposes to use SES-3 to replace AMC-1, SES is filing this as a replacement application, even though SES-3 is already in orbit. This approach is consistent with recent FCC actions. *See Intelsat License LLC*, Call Sign S2854, File No. SAT-RPL-20120216-00018, grant-stamped May 25, 2012 ("*Intelsat NSS-7 Grant*") (processing as a replacement satellite

A completed FCC Form 312 is attached. The information required by Section 25.114(c) is contained in the Schedule S database being submitted with this application, as supplemented by the narrative Technical Appendix. The information required by Section 25.114(d) is contained herein and in the narrative Technical Appendix.

I. INTRODUCTION

SES is legally and technically qualified to operate the SES-3 C- and Ku-band payloads as proposed herein. Grant of this application will serve the public interest by ensuring continuity of service for U.S. customers at 103° W.L.

A. SES Background

SES Americom is a pioneer and leading provider of satellite capacity in the United States. SES Americom has its headquarters in Princeton, New Jersey, and together with its affiliates provides U.S. and international satellite capacity through a fleet of over 50 geosynchronous communications satellites. SES Americom (then known as RCA American Communications, Inc.) launched its first domestic communications satellite in December 1975. Today, SES and its affiliates operate two dozen satellites with coverage of the United States, providing satellite capacity for broadcast and cable video distribution, VSAT data networks, remote communications, and government agencies.

Broadcasters, cable systems and video programmers use SES satellites to distribute programming and for specialized satellite newsgathering services. SES established

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application a request for authority to use Ku-band capacity on an in-orbit spacecraft). In a previous proceeding, the Commission staff had redesignated as an authority to operate application a request to use an in-orbit spacecraft as a replacement. *See DIRECTV Enterprises, LLC*, Order and Authorization, 20 FCC Rcd 15778 (Sat. Div. 2005) ("*DIRECTV 5 Order*") at 15779-80 & n.10 ("[t]ypically, a replacement satellite is a newly-built satellite") (citations omitted). SES has no objection to redesignation of this application as an authority to operate request if the Commission deems that to be appropriate.

one of the first cable satellite "neighborhoods" more than 20 years ago, and today continues to distribute cable television programming for the major cable networks. Virtually every U.S. cable and Direct Broadcast Satellite ("DBS") household receives some of its programming via the SES fleet. SES also has one of the largest satellite "neighborhoods" for the U.S. radio programming industry.

Dozens of specialized satellite-based communication networks have been designed, installed, maintained and serviced by SES for government organizations as diverse as the Department of State, NASA, NOAA, and the U.S. Armed Forces.[3] The company's satellites are also used to help provide basic voice, data and Internet communications to remote areas. As the demand increases for high-quality telecommunications, SES technical experts continue to develop innovative and cost-effective solutions to address customers' evolving needs.

SES has operated AMC-1 at 103° W.L. since late 1996, and the satellite's license term extends to October of 2016.[4] Offering prime North America coverage, the AMC-1 C-band payload is home to national television networks broadcasting to thousands of cable headends. The satellite's Ku-band beam supports distribution of major network television programming, as well as VSAT and broadband services for enterprise customers.

B. The SES-3 Spacecraft

SES requests a license to replace AMC-1 at 103° W.L. and operate SES-3 in order to ensure continuity of service for customers at this orbital location given the limited

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[3] Government services are provided by SES Americom's wholly-owned subsidiary, Americom Government Services, Inc., d/b/a SES Government Solutions.

[4] *See GE American Communications, Inc.* 3 FCC Rcd 6984 (Com. Car. Bur. 1988) (original license grant for what was then known as GE-1); *GTE Spacenet Corp. and GE American Communications, Inc.*, 9 FCC Rcd 1271 (Com. Car. Bur. 1994) ("*1994 GE-1 Order*") (reassigning GE-1 to 103° W.L.); *SES Americom, Inc.*, Call Sign S2445, File No. SAT-MOD-20110718-00130, grant-stamped Oct. 13, 2010 (extension of AMC-1 license term until Oct. 16, 2016, and grant of deorbit authority).

remaining service life for AMC-1.[5] SES is not seeking Commission authority to operate SES-3 in new frequencies or service areas.[6] SES will utilize SES-3 to continue to provide a range of video, broadband and data services, including direct-to-home ("DTH") services,[7] to users primarily in North America and the Caribbean. As with other satellites in the SES Americom fleet, SES will commercialize the satellite capacity on SES-3 on a non-common carrier basis by negotiating contracts individually with its customers.

SES-3 was originally constructed, launched and operated under Luxembourg authority at the nominal 99° W.L. orbital location. The spacecraft was launched on July 16, 2011. After in-orbit testing was performed at 77.25° W.L., SES-3 arrived at the nominal 99° W.L. orbital location in September 2011.[8] At that location, SES-3 operated on the 17/24 GHz BSS frequencies and C-band Telemetry, Tracking and Command ("TT&C") frequencies authorized by the administration of Luxembourg for slightly less than 90 days.

In December 2011, the satellite was relocated to the nominal 108.2° E.L. orbital location, where it was co-located with NSS-11, in response to anticipated U.S. government demand for Ku-band capacity in the Middle East. The satellite arrived at the nominal 108.2° E.L. orbital location in early February 2012. SES-3 remained at that location until July 2012 offering

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5 SES expects to seek authority to allow it to relocate AMC-1 to another orbital location once SES-3 is in place at 103° W.L.

6 SES seeks a license to operate SES-3 in the conventional C- and Ku-band frequencies currently used by AMC-1. As discussed above, SES is not seeking Commission authority to serve the U.S. using the Canadian-licensed Ciel 6i 17/24 GHz BSS payload aboard SES-3.

7 *See SES Americom, Inc., Order and Authorization*, 18 FCC Rcd 16589 (IB 2003) at ¶ 1 (authorizing the use of AMC-1 and other spacecraft in SES Americom's fleet for DTH would "promote fair and increased competition in the provision of satellite service in the United States" and would "provide benefits to the public by maximizing consumer choice.").

8 Prior to beginning the drift of SES-3 to the nominal 99° W.L. orbital location, SES entered into an agreement with Intelsat, operator of the Galaxy-16 spacecraft at 99.0° W.L., to specify the operational parameters and coordinate the stationkeeping boxes of the two satellites.

service on Ku-band FSS and BSS frequencies under authorizations granted by the administrations of Gibraltar and the Netherlands.

Weaker than anticipated demand from the U.S. government for Ku-band capacity at 108.2° E.L., coupled with the opportunity to provide service to Ciel in the 17/24 GHz BSS frequencies, resulted in a decision by SES to relocate SES-3 to the nominal 103° W.L. orbital location earlier than had previously been planned. The spacecraft is currently positioned at 103.1° W.L. with an east-west stationkeeping tolerance of +/- .05 degrees, adjacent to the stationkeeping volume of AMC-1. The satellite's C- and Ku-band TT&C frequencies have been authorized by the Luxembourg administration, and the TT&C ground stations are located outside the U.S.

SES requests expedited Commission grant of this application to permit an orderly transition of customer traffic from AMC-1 to SES-3. Extra time is expected to be needed for this transition because AMC-1 and SES-3 have different Ku-band polarization characteristics.[9]

II. GRANT OF AUTHORITY FOR SES-3 WILL SERVE THE PUBLIC INTEREST AND IS CONSISTENT WITH COMMISSION PRECEDENT

Authorizing operation of the SES-3 spacecraft at 103° W.L. will permit SES to provide service continuity for users from that orbital location. Furthermore, grant of the requested license is fully consistent with Commission precedent.

A. SES Is Entitled to a Replacement Expectancy at 103° W.L.

The Commission has expressly recognized a replacement expectancy for geostationary ("GSO") satellite operators:

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[9] Specifically, the AMC-1 Ku-band transponders have a polarization cant of 26 degrees. *See 1994 GE-1 Order*, 9 FCC Rcd at 1273-74, ¶¶18-19. In contrast, the SES-3 Ku-band transponders have horizontal and vertical polarization with no cant. *See* attached Technical Appendix, Section 2.1 and Table 1.

> Given the huge costs of building and operating GSO space stations, we have found that there should be some assurance that operators will be able to continue to serve their customers. Therefore, the Commission has stated that, when an orbit location remains available for a U.S. satellite with the technical characteristics of the proposed replacement satellite, it will generally authorize the replacement satellite at the same location.[10]

The Commission has also made clear that a replacement satellite need not be identical to the current spacecraft:

> We do not require replacement satellites to be technically *identical* to the existing satellite. We recognize that next-generation satellites will incorporate satellites with technical advancements made since the previous generation satellite was launched. We do not intend to change this policy, which facilitates state-of-the-art systems. Rather, we will continue to assess only whether operations of the replacement satellite will be consistent with our international coordination obligations pursuant to regulations promulgated by the International Telecommunication Union.[11]

As noted above, AMC-1 currently operates in the C- and Ku-band frequencies at 103° W.L., giving SES a replacement expectancy in those bands at that orbital location. The frequencies remain available for use by SES, and operation of SES-3 will conform to the Commission's international coordination obligations. The deployment of SES-3 will allow SES to use a state-of-the-art satellite to ensure long-term continuity of service for customers now using AMC-1. This is exactly what the Commission's long-standing replacement expectancy policy is designed to promote.

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[10] *Amendment of the Commission's Space Station Licensing Rules and Policies*, First Report and Order and Further Notice of Proposed Rulemaking, 18 FCC Rcd 10760, 10854-55 (2003) (footnotes omitted).

[11] *See id.* at 10857 (emphasis in original; footnotes omitted).

B. The Commission Has Licensed Spacecraft Previously Operated Pursuant to Foreign Authority

Grant of a U.S. license for SES-3, which was launched and initially operated pursuant to Luxembourg authority, is also consistent with Commission precedent. In numerous past cases, the Commission has issued licenses permitting spacecraft that were operating under foreign authority to serve as U.S.-authorized replacement or expansion satellites.

Most recently, the Commission granted Intelsat's application for U.S. licensing of certain Ku-band frequencies on the New Skies NSS-7 satellite as replacement capacity for NSS-5 at 20° W.L.[12] NSS-7 was launched pursuant to Netherlands authority, and had operated in the C- and Ku-bands under Netherlands authority prior to relocation of the satellite to 20° W.L.[13] Intelsat applied to operate a portion of the NSS-7 Ku-band payload at 20° W.L. under U.S. license, and the Commission processed the application as a replacement satellite filing.[14]

The satellite NSS-7 replaced, NSS-5, had a similar history. NSS-5 was launched as part of the INTELSAT intergovernmental system before it was spun-off to New Skies as part of the INTELSAT privatization. Since its spin-off to New Skies, the satellite's C- and Ku-band payloads have operated at a number of orbital locations under Netherlands authority.[15] In 2010,

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12 *See Intelsat NSS-7 Grant.*

13 Prior to its relocation, NSS-7 was operating at 22° W.L. under Netherlands license and had been placed on the Commission's Permitted Space Station List. *See New Skies Satellites N.V.*, Order, 17 FCC Rcd 10369 (IB 2002) (adding NSS-7 to the Permitted List for operations at 21.5º W.L.), as modified by File No. SAT-PDR-20020930-00179, grant-stamped May 29, 2003 (updating the Permitted List to reflect relocation of NSS-7 to 22º W.L.).

14 *See Intelsat NSS-7 Grant*, Attachment at 1 n.2 (granting the Intelsat application and noting that NSS-7 was to be used as a replacement for NSS-5 at 20° W.L.).

15 The Commission granted U.S. market access for NSS-5 (formerly known as NSS-803) at 21.5° W.L., *see New Skies Satellites, N.V.*, Order, 16 FCC Rcd. 7482 (Sat. Div. 2001), and revised its permitted space station list to allow continued U.S. market access for NSS-5 when the satellite was later relocated to 177° W.L. The satellite was removed from the permitted list in 2009 when it was moved to a location not capable of serving the U.S. Concurrently with the grant of authority to Intelsat to operate the NSS-5 Ku-band payload under U.S. license, the Commission placed the C-band payload of NSS-5, which remains Netherlands-licensed, back on

the Commission granted Intelsat's application for U.S. licensing of the Ku-band payload on the NSS-5 satellite as replacement capacity for Intelsat 603 at the nominal 20° W.L. orbital location.[16]

Similarly, the Commission granted a license to permit DIRECTV 5 to provide follow-on capacity at 109.8° W.L. when the spacecraft there suffered a malfunction.[17] DIRECTV 5 had originally operated under a U.S. license, but that license had been terminated when the spacecraft was redeployed for use under a Canadian license.[18] The Commission found that permitting DIRECTV 5 to resume U.S. service would allow "DIRECTV to maintain continuity of service to its customers from the 109.8° W.L. orbital location."[19]

The Commission has also issued U.S. operating licenses for satellites purchased following launch. For example, the Commission granted Intelsat's request for U.S. authority to operate ProtoStar 1, which it had purchased in the ProtoStar bankruptcy proceeding.[20] Intelsat used ProtoStar 1 to provide follow-on capacity to services that were being provided by Intelsat 801 at 31.5° W.L.[21] Similarly, when the satellite intended to be AsiaSat 3 suffered a

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the permitted list for service to U.S. earth stations. *See New Skies Satellites B.V.,* Call Sign S2802, File Nos. SAT-PPL-20091208-00142 & SAT-APL-20100219-00034, grant-stamped June 4, 2010.

16 *Intelsat License LLC*, Call Sign S2801, File No. SAT-A/O-20091208-00141, grant-stamped June 4, 2010 ("*Intelsat NSS-5 Grant*"), Attachment to Grant at 1 & n.2 (granting the Intelsat application and noting that NSS-5 was to be used as a replacement for Intelsat 603 at 20° W.L., but also included bands not present on Intelsat 603).

17 *See DIRECTV 5 Order* at ¶¶ 3-4.

18 *See id.* at ¶ 3.

19 *See id.* at ¶ 1. Like DIRECTV 5, the SES Americom AMC-16 spacecraft was operated for an interim period pursuant to Canadian license before being returned to serve under U.S. license. *See SES Americom, Inc. and EchoStar Satellite L.L.C.,* Order and Authorization, 21 FCC Rcd 3430 (IB 2006) ("*AMC-16 Relocation Order*") at ¶ 1.

20 *Intelsat North America LLC,* File No. SAT-A/O-20091223-00151, Call Sign S2804 ("ProtoStar 1 Application"), grant-stamped Apr. 2, 2010.

21 ProtoStar 1 Application, Narrative at 1.

launch malfunction, the Commission allowed PanAmSat to operate the satellite (known as HGS-1 or PAS 22) under U.S. special temporary authority.[22]

These examples are consistent with precedent dating back to 1998, when the Commission considered a proposal for relicensing of the MSAT-1 spacecraft.[23] That spacecraft had been launched and begun operations under a Canadian authorization. AMSC planned to relocate its own AMSC-1 spacecraft to serve Africa and sought to use MSAT-1 in its place for U.S. coverage, proposing that MSAT-1 be operated under joint U.S. and Canadian authority.[24] The International Bureau stated that it saw no obstacle to the proposed joint licensing of MSAT-1, and authorized AMSC's fixed and mobile earth stations to communicate with the MSAT-1 satellite.[25]

This line of cases establishes that there is no regulatory obstacle to the proposed transition of the SES-3 C- and Ku-band payloads from a foreign to a U.S. authorization. The Commission has uniformly granted requests for a U.S. operating license where doing so will permit a satellite previously operating under foreign authority to be used to ensure service continuity for U.S. customers, as with NSS-7, NSS-5, DIRECTV 5, Protostar 1 and MSAT-1, or will otherwise permit efficient use of in-orbit capacity, as with HGS-1.

The proposed U.S. licensing of SES-3 fits squarely within this precedent. The transition of the SES-3 C- and Ku-band payloads to U.S. authority will permit efficient use of an operational spacecraft to bring follow-on capacity to existing U.S. customers. Accordingly,

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[22] *PanAmSat Corp.*, Order and Authorization, DA 99-2220 (IB rel. Oct. 26, 1999).

[23] *AMSC Subsidiary Corp.*, Order and Authorization, 13 FCC Rcd 12316 (IB 1998) ("*AMSC Order")* at ¶ 17.

[24] *Id.* at ¶ 3.

[25] *Id.*, at ¶¶ 17 & 19. Ultimately, the proposed relocation of AMSC-1 did not occur, and AMSC's traffic remained on that satellite.

consistent with the decisions cited above, the Commission should determine that grant of the requested U.S. license for SES-3 will serve the public interest.

C. Dual Licensing of SES-3 Is Consistent with Commission Precedent

There is also ample precedent for licensing the SES-3 C- and Ku-band payloads as U.S. while the 17/24 GHz BSS payload remains under Canadian license. The Commission has repeatedly authorized such dual licensing arrangements.

The Commission's initial analysis of dual licensing came in the *AMSC Order* discussed above. In that decision, the International Bureau stated that:

> We do not foresee any insurmountable difficulties with respect to AMSC's proposal for joint U.S.-Canadian licensing and coordination responsibility for MSAT-1. While this is the first time the Commission has been asked to 'share' a satellite with another licensing administration, there appears to be nothing in the international Radio Regulations that would preclude such an arrangement.[26]

Subsequent to that ruling, the Commission has approved dual licensing in a number of cases. In some instances, dual licensing has been contemplated from the beginning, and the Commission has routinely licensed U.S. payloads on satellites where another payload is to be operated under foreign authority.[27] In other instances, a portion of an otherwise foreign-licensed satellite's capacity has been transitioned to U.S. licensing jurisdiction. Examples of the

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26 *AMSC Order* at ¶ 17.

27 *See, e.g.*, *Lockheed Martin Corp.*, Order and Authorization, 20 FCC Rcd 14558 (Sat. Div. 2005) (authorizing launch and operation of a radionavigation payload onboard the Canadian-licensed Anik-F1R satellite); *PanAmSat Licensee Corp.,* Order and Authorization, 18 FCC Rcd 19680 (Sat. Div. 2003) ("*Galaxy 13/Horizons I Order*") (authorizing launch and C-band operation of Galaxy 13, which also carries a Japanese-licensed Horizons I Ku-band payload); *EchoStar Satellite Corp.,* Order and Authorization, 18 FCC Rcd 15862 (Sat. Div. 2003) ("*EchoStar 9/Telstar 13 Order*") (authorizing the EchoStar 9 Ku- and Ka-band spacecraft and noting that the satellite also included the Telstar 13 C-band payload to be operated by Loral under authority granted by Papua New Guinea).

latter scenario include the U.S. licensing of Ku-band capacity on the NSS-7 and NSS-5 satellites, while the remaining frequencies remained subject to Netherlands licensing.[28]

These arrangements allow satellites to be efficiently designed with multiple payloads on a single spacecraft bus. Dual licensing permits the various payloads to be operated pursuant to different administrations' International Telecommunication Union ("ITU") filings,[29] which ensures that customer traffic can be effectively protected from harmful interference.

Grant of a U.S. license for the SES-3 C- and Ku-band payloads is consistent with these policies. The Commission's practice in dual licensing situations is to enter into an exchange of letters with the other licensing administration to ensure a mutual understanding regarding spacecraft operations.[30] SES respectfully requests that the Commission commence discussions with Industry Canada to develop the terms and conditions for dual-licensed operation of SES-3.

III. THE COMMISSION SHOULD GRANT ANY NECESSARY WAIVER OF SECTION 25.113(g)

The C- and Ku-band payloads of SES-3 fully comply with Commission rules. Thus, no technical waivers are needed in connection with the request for U.S. licensing of these payloads.

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[28] *See Intelsat NSS-7 Grant; Intelsat NSS-5 Grant*.

[29] *See Intelsat License LLC*, Call Sign S2854, File No. SAT-RPL-20120216-00018 ("Intelsat NSS-7 Application"), Narrative at 3 (noting that the Dutch administration has effective priority in the C-band, while the U.S. has priority in certain Ku-band frequencies at 20° W.L.).

[30] *See, e.g., Galaxy 13/Horizons I Order*, 18 FCC Rcd at 19685-88 (exchange of letters with Ministry of Public Management, Home Affairs, Posts and Telecommunications of Japan); *EchoStar 9/Telstar 13 Order*, 18 FCC Rcd at 15871-74 (exchange of letters with Papua New Guinea Radiocommunications and Telecommunications Technical Authority); *Intelsat NSS-7 Grant*, Attachment to Grant at 3, ¶ 12 & Annex A (exchange of letters with Netherlands Radio Communications Agency). *See also AMC-16 Relocation Order*, 21 FCC Rcd at 3438-41 (exchange of letters with Industry Canada).

The issuance of a Commission authorization for operation of these payloads is also consistent with the terms of Section 25.113(g), notwithstanding the fact that SES-3 was launched and initially operated under foreign authority. In pertinent part, Section 25.113(g) provides that:

> [A] launch authorization and station license (*i.e.*, operating authority) must be applied for and granted before a space station may be launched and operated in orbit. Request for launch authorization may be included in an application for space station license.[31]

As a threshold matter, the rule does not state that the launch of a satellite must occur pursuant to U.S. authority in order for operation of the satellite to be authorized by the Commission. To the contrary, the rule's declaration that the request for launch authorization "may be included" in the application for operating authority indicates that seeking operating authority separate from the launch authority is also permissible. In this case, prior to SES-3 being "launched and operated in orbit" as described in the rule, SES received all necessary authority from the Luxembourg Ministry of State, Office of Media and Communications.[32]

Furthermore, as discussed above, the Commission has granted operating authority for satellites or payloads that were launched and previously operated under a foreign jurisdiction's authority. The decisions involving MSAT-1, HGS-1, Protostar 1, NSS-5 and NSS-7 are silent on Section 25.113(g). In fact, SES has not discovered any decision in which the Commission refused to grant U.S. operational authority to a satellite launched pursuant to foreign authority in reliance on Section 25.113(g).[33]

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[31] 47 C.F.R. § 25.113(g).

[32] Ministère d'État, Service des Médias et des Communications of the Grand Duchy of Luxembourg (the "Luxembourg Ministry").

[33] The cases that rely on Section 25.113(g) typically involve situations in which an applicant seeking U.S. authority to launch a spacecraft has not provided technical information regarding all

Thus, both the language of Section 25.113(g) and the relevant case law indicate that grant of a U.S. license for the SES-3 C- and Ku-band payloads is appropriate. There is no relevant difference between the factual circumstances in the prior cases involving MSAT-1, HGS-1, Protostar 1, NSS-5 and NSS-7 and those presented here. Because the Commission is obligated to treat similarly-situated applicants similarly,[34] the Commission must conclude that Section 25.113(g) does not bar a grant of operational authority in the case of SES-3.

To the extent the Commission nevertheless determines that a waiver of Section 25.113(g) is required to allow U.S. licensing of the SES-3 C- and Ku-band payloads, SES respectfully requests grant of such a waiver. Such a waiver is consistent with Commission policy:

> The Commission may waive a rule for good cause shown. Waiver is appropriate if special circumstances warrant a deviation from the general rule and such deviation would better serve the public interest than would strict adherence to the general rule. Generally, the Commission may grant a waiver of its rules in a particular case if the relief requested would not undermine the policy objective of the rule in question and would otherwise serve the public interest.[35]

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of the payloads. *See, e.g.,* Letter of Robert G. Nelson, Chief, Satellite Division, to Stephen L. Goodman and Walter H. Sonnenfeldt, 22 FCC Rcd 17772, DA 07-4160 (dated Oct. 5, 2007) ("*Orbcomm Letter*") (dismissing as defective a request for launch authority for satellites that proposed non-compliant tracking, telemetry and control operations without seeking a waiver of the Commission's rules). For example, the Commission relied on this rule in its partial dismissal of the initial application for the SES-1 spacecraft. Letter of Robert G. Nelson, Chief, Satellite Division, to Daniel C.H. Mah, 25 FCC Rcd 2112, DA 10-362 (dated Mar. 2, 2010) ("*SES-1 Letter*"). The Commission indicated that "technical information relating to the [SES-1] 17/24 GHz payload is required because SES Americom is seeking *construction and launch* authority for this payload and contemplates operating the payload for testing purposes at another orbital location." *Id.* at 2112 (emphasis added), *citing* 47 C.F.R. § 25.113(g). In contrast to the SES-1 proceeding, SES did not seek authority from the U.S. for the construction and launch of SES-3 because the spacecraft was built and launched pursuant to Luxembourg authorization.

[34] *See, e.g., Freeman Engineering Assoc., Inc. v. Federal Communications Commission,* 103 F.3d 169 (D.C. Cir. 1997); *Melody Music, Inc. v. Federal Communications Commission,* 345 F.2d 730 (D.C. Cir. 1965).

[35] *PanAmSat Licensee Corp.*, 17 FCC Rcd 10483, 10492 (Sat. Div. 2002) (footnotes omitted).

In cases applying Section 25.113(g), the rule is frequently cited in tandem with ITU Radio Regulation 18.1, which requires a license for a private person or enterprise to establish or operate a transmitting station.[36] This suggests that the rules have a similar underlying purpose: to ensure that radio transmitting facilities operate only pursuant to regulatory oversight.

Grant of U.S. operational authority for the SES-3 C- and Ku-band payloads is fully consistent with that objective. As discussed above, the launch and initial operations of SES-3 occurred pursuant to authorization from the Luxembourg Ministry. All subsequent operations of the satellite since its launch have also been authorized by the regulatory bodies of Luxembourg, Gibraltar, and/or Canada, depending on the orbital location and frequency band used. All these administrations have robust regulatory frameworks to ensure that operation of spacecraft under their jurisdiction complies with international law.

Thus, grant of any necessary waiver of Section 25.113(g) is justified because U.S. licensing of SES-3's C- and Ku-band capacity will serve the public interest in service continuity and will not undermine the purpose of the rule. Waiving Section 25.113(g) in connection with conferring a U.S. operating license for the SES-3 C- and Ku-band payloads would simply represent the orderly transfer of licensing jurisdiction from one administration to another, consistent with Commission policy and precedent.

IV. LIMITED WAIVERS OF 17/24 GHz BSS INFORMATION REQUIREMENTS SHOULD BE GRANTED

As noted above, SES is not seeking Commission authority in connection with the SES-3 17/24 GHz BSS payload, but is providing technical information regarding the payload for the Commission's records. In these circumstances, SES believes that Commission requirements

[36] *See SES-1 Letter*, 25 FCC Rcd at 2112 n.2; *Orbcomm Letter*, 22 FCC Rcd at 17773 n.7.

concerning 17/24 GHz BSS operations do not apply to SES-3. Nevertheless, out of an abundance of caution, SES seeks any required waivers of Sections 25.114(d)(3) and 25.264(c) and (d), which specify information that must be provided in support of an application in the 17/24 GHz BSS frequencies.

Section 25.114(d)(3): Section 25.114(d)(3) provides that space station antenna gain contours "should be plotted on an area map at 2 dB intervals down to 10 dB below the peak value of the parameter and at 5 dB intervals between 10 dB and 20 dB below the peak values."[37] The 17/24 GHz payload coverage maps provided in the attached Technical Appendix for information purposes only portray the -2, -4, -6, -8, -10, and -12 dB contours but do not include a -15 or -20 dB contour because these contours are beyond the edge of the globe.[38]

The Commission has routinely granted waivers of the contour map specification requirements where the information provided by the applicant sufficiently describes the space station's antenna characteristics.[39] Grant of any necessary waiver here is consistent with this precedent.

Sections 25.264(c) and (d): In June 2011, the Commission adopted rule provisions to mitigate the possibility of space path interference between the downlink signals of 17/24 GHz BSS satellites and the feeder links for DBS networks.[40] The Commission established

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[37] 47 C.F.R. § 25.114(d)(3).

[38] *See* Technical Appendix, Annex 1, Figures A1.9 & A1.10.

[39] *See, e.g.*, *SES Americom, Inc.*, Call Sign S2826, File No. SAT-RPL-20110429-00082, grant-stamped Sept. 1, 2011, Attachment to Grant at 2-3 ¶ 6(e) (requiring additional gain contour information for SES-2 17/24 GHz BSS payload "would not provide any useful information and would not otherwise serve the public interest"); *Intelsat North America LLC*, Call Sign S2789, File No. SAT-LOA-20090410-00043, grant-stamped Nov. 25, 2009 (waiver of Section 25.114(d)(3) appropriate where technical materials provide "a sufficiently complete description of the transponder characteristics").

[40] *Establishment of Policies and Service Rules for the Broadcasting-Satellite Service at the 17.3-17.7 GHz Frequency Band and at the 17.7-17.8 GHz Frequency Band Internationally, and*

a two-step procedure for submitting data regarding characteristics for 17/24 GHz BSS satellites to allow DBS operators to assess the risk of space path interference.[41] Specifically, the Commission mandated that each application for a 17/24 GHz BSS license include information regarding the satellite's predicted transmitting antenna off-axis gain and power flux density and that the applicant subsequently provide measured data for these parameters no later than nine months prior to the satellite's launch.[42] The requirements took effect on March 15, 2012.[43]

These provisions are not triggered here because SES is not an applicant for a satellite license in the 17/24 GHz BSS bands, nor does it hold a Commission authorization for operations in that band.[44] Nevertheless, SES has included in the attached Technical Appendix predicted transmitting antenna off-axis gain and power flux density information for the SES-3 17/24 GHz payload that complies with the specifications of Sections 25.264(a) and (b).[45]

SES has also provided the available measured data responsive to Sections 25.264(c) and (d).[46] SES, however, does not have measured data for the full range of parameters specified in those rule provisions. Accordingly, SES seeks any necessary waiver of these information requirements.

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at the 24.75-25.25 GHz Frequency Band for Fixed Satellite Services Providing Feeder Links to the Broadcasting-Satellite Service and for the Satellite Services Operating Bi-directionally in the 17.3-17.8 GHz Frequency Band, Second Report and Order ("17/24 GHz Second Order"), 26 FCC Rcd 8927 (2011).

[41] *See id.* at 8947-8951.

[42] *See id.* at 8950. The requirements relating to submission of predicted data are codified in 47 C.F.R. §§ 25.264(a) and (b), and the requirements for submission of confirming measured data are codified in 47 C.F.R. §§ 25.264(c) and (d).

[43] *See* 76 Fed. Reg. 79110 (Dec. 21, 2011).

[44] The requirements of Sections 25.264(a) and (b) expressly apply only to an "applicant for a space station license" in the 17/24 GHz BSS frequencies, and the requirements of Sections 25.264(c) and (d) apply only to a "17/24 GHz BSS space station applicant or authorization holder."

[45] *See* Technical Appendix, Annex 2 Section 2.2 and Figures A2.17 & A2.18.

[46] *See id.*, Figures A2.19 & A2.20.

Grant of the waiver is consistent with Commission policy. At the time the Commission released the final rules for mitigating space path interference in June 2011, the scheduled launch date for SES-3 was less than a month away and the satellite had already been shipped to the launch site. As a result, it was not possible to perform testing to obtain the measured data specified by Sections 25.264(c) and (d) consistent with the satellite's launch schedule. Furthermore, there is no practical way to conduct the testing now that the satellite is in orbit.

The requested waiver will not contravene the underlying purpose of Sections 25.264(c) and (d), which is to mitigate the potential for space path interference to DBS operations. The nominal orbital location of SES-3 is two degrees away from the center of the nearest DBS cluster. The DBS operators have acknowledged that interference is unlikely even at half this distance. This assessment is borne out by the available data regarding SES-3, which confirms that the satellite's power flux density is below the coordination trigger included in the Commission's rules for any orbital separation of 0.01 degrees or greater.[47]

Under these circumstances, granting any necessary waiver of the information requirements in Sections 25.264(c) and (d) recognizes the practical impossibility of retroactively complying with rules that did not take effect until after SES-3 was launched. The waiver will not undermine the objectives of these rules and is therefore in the public interest.

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[47] *See id.*, Figure A2.21.

V. CONCLUSION

SES requests expedited authority to operate the SES-3 C- and Ku-band payloads under Commission license as a replacement for the capacity in those bands on AMC-1. Grant of this application will serve the public interest, convenience, and necessity by allowing SES to provide follow-on capacity to ensure service continuity at the 103° W.L. orbital location.

Respectfully submitted,

SES AMERICOM, INC.

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Attachment A

TECHNICAL APPENDIX

IN SUPPORT OF SES-3 (103°W.L.)

1 Overall Description

SES-3 is a hybrid C- and Ku-band communications satellite that is intended to replace AMC-1 at 103° W.L. At that orbital location, the satellite will be serving primarily: (a) the Contiguous USA (CONUS), Hawaii and parts of Alaska, Canada and Mexico in the Ku-band, and (b) CONUS and parts of Alaska, Hawaii, Canada, Mexico and the Caribbean in the C-band.

SES Americom, Inc. ("SES") is requesting U.S. authority to operate SES-3 in the following frequency bands at 103° W.L.:

- Conventional Ku-band frequencies with downlink frequencies from 11.70 to 12.20 GHz and uplink frequencies from 14.0 to 14.5 GHz
- Conventional C-band frequencies with downlink frequencies from 3.70 to 4.20 GHz and uplink frequencies from 5.925 to 6.425 GHz

The spacecraft also has a Canadian-licensed 17/24 GHz broadcasting-satellite service ("BSS") payload on board with downlink frequencies from 17.3 to 17.8 GHz and uplink frequencies from 24.75 to 25.25 GHz. No U.S. authority is being sought for this payload, but a technical description of the payload is provided herein for informational purposes.

Dual linear polarization is used in both the C- and Ku-bands. Single circular polarization (LHCP) is used in the 17/24 GHz uplink band, and dual circular polarization is used in the 17/24 GHz downlink band.

Tables 1 and 2 show the frequency plans of the satellite. The frequency bands are divided into 24 C-band transponders of 36 MHz bandwidth each, and 24 Ku-band transponders of 36 MHz bandwidth each. Transponders 14, 16, 18, 20, 22, and 24 can be operated in cross-strapped mode.[1]

2 Schedule S

The Schedule S database is attached as an electronic file. The following items supplement the information provided in Schedule S.

[1] A cross-strapped transponder has C-band uplink and Ku-band downlink, or Ku-band uplink and C-band downlink.

2.1 Transponder frequency plan

Sections S9 and S10 of Schedule S (and Tables 1 and 2 below) show the transponder frequency plans. Beams with IDs KRV, KTV, KRH and KTH provide coverage primarily over CONUS, Hawaii and parts of Alaska, Canada and Mexico. Beams with IDs CRRV, CRTV, CRRH and CRTH provide coverage primarily of CONUS and parts of Alaska, Hawaii, Canada, Mexico and the Caribbean.

Transponders K01 to K24 connect beams KRV and KTH, and KRH and KTV. Transponders C01 to C24 connect beams CRV and CTH, and CRH and CTV. Cross-strapped transponders X01 to X06 connect uplinks KR14, KR16, KR18, KR20, KR22, and KR24, respectively, to downlinks CT14, CT16, CT18, CT20, CT22, and CT24, respectively. Cross-strapped transponders X07 to X12 connect uplinks CR14, CR16, CR18, CR20, CR22, and CR24, respectively, to downlinks KT14, KT16, KT18, KT20, KT22, and KT24, respectively.

The 17/24 GHz payload consists of a transponder powered by a single TWTA, with a single uplink beam (KAR) and downlink beams in each of the two circular polarizations (KATR and KATL). This single transponder can support multiple carriers of variable bandwidth across the entire band and, thus, a variety of frequency plans. In a typical operational scenario, the uplink and downlink frequencies on this transponder would be divided into 14 uplink and downlink "channels" of 31 MHz bandwidth (consisting of multiple carriers with a total bandwidth of 31 MHz), and 34.3 MHz channel spacing using single polarization. This typical channel plan is depicted at Section S9 of the Schedule S:

- 14 uplink channels labeled as KAR01 through KAR14
- 14 downlink channels labeled as KAT01 through KAT14 with RHCP polarization and
- 14 downlink channels labeled as KAT15 through KAT28 with LHCP polarization.

Section S10 of the Schedule S shows how each uplink channel would correspond to each downlink channel in the typical scenario. However, due to the limitations in the Schedule S software and form, SES was forced to assign a different Transponder ID to each row of Section S10 in order to show this correspondence. These different Transponder IDs in Section S10 should be understood as all referring to the same, single 17/24 GHz BSS transponder on SES-3.

Table 1: Ku-band Frequency Plan

Channel	Receive Frequency (MHz)	Polarization	Transmit Frequency (MHz)	Polarization
1	14020	V	11720	H
2	14040	H	11740	V
3	14060	V	11760	H
4	14080	H	11780	V
5	14100	V	11800	H
6	14120	H	11820	V
7	14140	V	11840	H
8	14160	H	11860	V
9	14180	V	11880	H
10	14200	H	11900	V
11	14220	V	11920	H
12	14240	H	11940	V
13	14260	V	11960	H
14	14280	H	11980	V
15	14300	V	12000	H
16	14320	H	12020	V
17	14340	V	12040	H
18	14360	H	12060	V
19	14380	V	12080	H
20	14400	H	12100	V
21	14420	V	12120	H
22	14440	H	12140	V
23	14460	V	12160	H
24	14480	H	12180	V

Table 2: C-band Frequency Plan

Channel	Receive Frequency (MHz)	Polarization	Transmit Frequency (MHz)	Polarization
1	5945	V	3720	H
2	5965	H	3740	V
3	5985	V	3760	H
4	6005	H	3780	V
5	6025	V	3800	H
6	6045	H	3820	V
7	6065	V	3840	H
8	6085	H	3860	V
9	6105	V	3880	H
10	6125	H	3900	V
11	6145	V	3920	H
12	6165	H	3940	V
13	6185	V	3960	H
14	6205	H	3980	V
15	6225	V	4000	H
16	6245	H	4020	V
17	6265	V	4040	H
18	6285	H	4060	V
19	6305	V	4080	H
20	6325	H	4100	V
21	6345	V	4120	H
22	6365	H	4140	V
23	6385	V	4160	H
24	6405	H	4180	V

2.2 TWTA redundancy

2.2.1 Ku-band

The communications receivers are configured in a 4-for-2 redundancy (as a minimum) with cross-strapping between polarizations and coverage beams such that any two receivers can complete the mission. Twenty-four (24) operational frequencies utilizing 36 MHz bandwidth are provided by thirty-two (32) High Power Amplifiers (HPAs) arranged in two groups of 16-for-12.

2.2.2 C-band

The communications receivers are configured in a 4-for-2 redundancy (as a minimum) with cross-strapping between polarizations and coverage beams such that any two receivers can complete the mission. Twenty-four (24) operational frequencies utilizing 36 MHz bandwidth are provided by thirty-two (32) HPAs arranged in two groups of 16-for-12.

2.2.3 17/24 GHz band

The communications receivers are configured in a 2-for-1 redundancy. One (1) operational frequency utilizing 500 MHz bandwidth is provided by one (1) HPA arranged in a 2-for-1 configuration.

2.3 Saturation Flux Density values

SFD values can be obtained by using the following expressions:

Ku-band:	SFD = -94 – (G/T) + Transponder Gain Setting	dBW/m^2
C-band:	SFD = -96 – (G/T) + Transponder Gain Setting	dBW/m^2
17/24 GHz band:	SFD = -103 – (G/T) + Transponder Gain Setting	dBW/m^2

2.4 Transponder frequency response

The frequency response and total group delay, specified over the transponder bandwidth, are provided in Tables 3 to 6 below.

As noted above, the 17/24 GHz payload uses a single TWTA. The payload also has single input and output filters for the entire 500 MHz band. Table 7 shows the filter characteristics.

Table 3: Ku-band Transponder Frequency Response

	Frequency Offset (MHz)	dB p-p
36 MHz channel	±14	1.2
	±16	1.5
	±18	3.6

Table 4: C-band Transponder Frequency Response

	Frequency Offset (MHz)	dB p-p
36 MHz channel	±14	1.0
	±16	1.3
	±18	2.4

Table 5: Ku-band Transponder Total Group Delay

	Frequency Offset (MHz)	Relative Group Delay (ns p-p)
36 MHz channel	0	6.0
	±8	9.0
	±12	16.0
	±16	45.0
	±18	85.0

Table 6: C-band Transponder Total Group Delay

	Frequency Offset (MHz)	Relative Group Delay (ns p-p)
36 MHz channel	0	4.0
	±8	8.5
	±12	16.0
	±16	50.0
	±18	84.0

Table 7: Input and output channel filter characteristics (frequency band: 17.3-17.8 GHz)

Offset from center frequency, MHz	Input filter Insertion loss variation, dBp-p, max	Input filter Group delay variation, ns, max	Output filter Insertion loss variation, dBp-p, max	Output filter Group delay variation, ns, max
± 125	0.15	0.8	0.1	0.4
± 150	0.2	1	0.1	0.5
± 175	0.3	1.4	0.15	0.6
± 200	0.4	2	0.2	0.8
± 225	0.55	3	0.25	1.1
± 250	0.8	5	0.4	1.9

2.5 Telemetry and Telecommand (TT&C) frequencies and beams

Table 8 shows the TT&C carrier center frequencies and bandwidths. The TT&C carriers use communication antennas during normal operation.

Table 8: TT&C Carrier Frequencies

Command carriers (bandwidth: 1.0 MHz, capture range)	Frequency, MHz	Nominal polarization
C-band	6423.5	V
Ku-band	14499.0	V

Beacons/Telemetry (bandwidth: 400 KHz)	Frequency, MHz	Nominal polarization
C-band pair	3700.5	V
	4199.5	H
Ku-band pair	11701.0	V
	12199.0	H

Note: For emergency mode, TT&C reverts to a horn antenna using circular pol; CMD = LHCP and TLM = RHCP

2.5.1 Command carrier characteristics and link budgets

a. Bandwidth (2-sided): 1.0 MHz

b. Capture range (2-sided): 2.0 MHz

c. Transmit earth station sidelobe envelope: 29 – 25 log θ, dB

d. Uplink saturated flux density at the satellite: -92 dBW/m^2 to -60 dBW/m^2

Table 9 shows the command carrier link budgets in the Ku- and C-bands, respectively.

Table 9: Ku-band and C-band Command Carrier Link Budgets

	Ku-band	**C-band**
TX earth station antenna diameter (m)	8.4	13
TX earth station antenna gain (dBi)	60.2	57.0
TX earth station input power (dBW)	10	10
TX earth station EIRP (dBW)	70.2	67.0
Link loss (dB)	207.5	200.1
Satellite G/T (dB/K)	6	2
Command carrier bandwidth (MHz)	1	1
TX earth station input power density (dBW/Hz)	-50	-50
C/N (dB)	37.3	37.5
C/N Required (dB)	10	10
Margin	27.3	27.5

2.5.2 Telemetry/Beacon carrier link budgets

Table 10 shows telemetry link budgets with an EIRP minimum of 10 dBW in the coverage area.

Table 10: Ku-band and C-band Telemetry Link Budgets

	Ku-band	C-band
EIRP (dBW)	19	16
Carrier bandwidth (MHz)	0.5	0.5
EIRP density (dBW/4 kHz)	-1.97	-4.97
RX earth station antenna diameter (m)	5.7	4.5
RX earth station antenna gain (dBi)	55.0	43.0
RX earth station antenna G/T (dB/K)	34.6	22.5
Rain fade (dB)	8	1
C/N (dB)	10.21	9.16
C/N Required (dB)	9	9
Margin	1.2	0.2

3 Satellite Antenna Gain Contours

Annex 1 shows the antenna gain contours for 8 different cases: transmit and receive beams, H- and V-polarizations for Ku- and C-bands. Table 11 shows the correspondence between peak gains of the antennas and maximum EIRP or G/T values.

Table 11: Maximum Co-pol Gain, EIRP, and G/T Values

		Ku-band		C-band	
		H-pol	V-pol	H-pol	V-pol
Transmit beam	Gain (max.), dBi	36.1	34.9	31.3	31.2
	EIRP (max.), dBW	53.3	52.5	42.1	42.1
Receive beam	Gain (max.), dBi	34.3	34.5	31.5	31.9
	G/T (max), dB/K	7.0	7.0	5.0	5.3

These files with co-pol data are also provided as .gxt files in Schedule S:

1. CRV.gxt (V-pol, C-band receive beam)
2. CTV.gxt (V-pol, C-band transmit beam)
3. CRH.gxt (H-pol, C-band receive beam)
4. CTH.gxt (H-pol, C-band transmit beam)
5. KRH.gxt (H-pol, Ku-band receive beam)
6. KTH.gxt (H-pol, Ku-band transmit beam)
7. KRV.gxt (V-pol, Ku-band receive beam)
8. KTV.gxt (V-pol, Ku-band transmit beam)

Annex 1 also shows the 17/24 GHz antenna gain contours for transmit and receive beams, which use horn antennas. Schedule S includes the footprints of transmit and receive antennas (files KAR.gxt, KATR.gxt and KATL.gxt). The gain contours are only shown to -12 dBi instead of down to -20 dBi as requested in Section 25.114(d)(3), because the -15 and -20 dBi gain contours do not intersect the earth.

In addition, section S7 of Schedule S shows the maximum gains of transmit and receive antennas, maximum EIRP, and maximum G/T values.

4 Emission Designators and Link Budgets

The services provided by SES-3 will be wide ranging, including digital TV and digital transmission services ranging from 56 KBPS to high-speed. Sample link budgets for these services follow. Table 12 provides the characteristics of the earth stations used for this analysis and estimated link margins for Ku-band carriers. Table 13 shows similar results for the C-band carriers.

Table 14 shows analog TV/FM (emission designator 36M0F3F) link budgets for Ku-band and C-band carriers. Table 15 shows a typical 17/24 GHz link budget.

Table 12: Ku-band Link Budgets for 7 Typical Links

Parameter	Digital TV MCPC 40 Mbps QPSK ¾ RS	Digital TV MCPC 32 Mbps QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	56 Kbps QPSK ¾ RS	1.544 Mbps QPSK ¾ RS	Digital TV MCPC 50 Mbps 8PSK ⅔ RS
Carrier designation	36M0G7W	27M0G7W	6M95G1W	5M00G1W	100KG1W	1M60G1W	36M0G7W
Noise bandwidth (MHz)	36	27	7	5	0.100	1.600	36
Uplinks:							
Transmit Power (dBW)	20	20	8.9	8.9	-2	8	20
Transmit Loss (dB)	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5
TX earth station antenna diameter (m)	6	6	6	6	6	6	6
TX earth station antenna gain (dBi)	57.2	57.2	57.2	57.2	57.2	57.2	57.2
TX earth station antenna EIRP (dBW)	74.7	74.7	63.6	63.6	52.7	62.7	74.7
Uplink Rain Loss (dB)	-2	-2	-2	-2	-2	-2	-2
Free Space Loss (dB)	-207	-207	-207	-207	-207	-207	-207
Satellite G/T (dB/K)	3	3	3	3	3	3	3
Boltzmann's Constant (dBW/K-Hz)	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
C/N uplink (dB)	21.7	23.0	17.7	19.2	25.3	23.2	21.7
C/I uplink (dB)	27.6	28.9	23.6	25.1	31.2	29.1	27.6
C/N+I uplink (dB)	20.7	22.0	16.7	18.2	24.3	22.2	20.7
Downlinks:							
Satellite Carrier EIRP (dBW)	49.5	48.3	38.4	36.9	19.9	32.0	45.5
Interference bandwidth (MHz)	36.0	27.0	7.0	5.0	0.1	1.6	36.0
Satellite EIRP density (dBW/4KHz)	9.96	9.96	5.96	5.96	5.96	5.96	5.96
Downlink Rain Loss (dB)	-3	-3	-3	-3	-3	-3	-3
Free Space Loss (dB)	-205.4	-205.4	-205.4	-205.4	-205.4	-205.4	-205.4
RX earth station antenna diameter (m)	1.2	1.2	1.2	1.8	1.8	1.8	1.2
RX earth station antenna G/T (dB/K)	21.7	21.7	21.7	25.2	25.2	25.2	21.7
C/N downlink (dB)	15.8	15.8	11.8	15.4	15.4	15.4	11.8
C/I downlink (dB)	17.6	17.6	13.6	17.2	17.2	17.2	13.6
C/N+I downlink (dB)	13.6	13.6	9.6	13.2	13.2	13.2	9.6
C/N system (dB)	14.8	15.1	10.8	13.9	14.9	14.7	11.4
C/I system (dB)	17.2	17.3	13.2	16.5	17.0	16.9	13.5
C/N+I system (dB)	12.9	13.0	8.9	12.0	12.8	12.7	9.3

Table 13: C-band Link Budgets for 7 Typical Links

Parameter	Digital TV MCPC 40 Mbps QPSK ¾ RS	Digital TV MCPC 32 Mbps QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	Digital TV SCPC QPSK ¾ RS	56 Kbps QPSK ¾ RS	1.544 Mbps QPSK ¾ RS	Digital TV MCPC 50 Mbps 8PSK ⅔ RS
Carrier designation	36M0G7W	27M0G7W	6M95G1W	5M00G1W	100KG1W	1M60G1W	36M0G7W
Noise bandwidth (MHz)	36	27	7	5	0.100	1.600	36
Uplinks:							
Transmit Power (dBW)	25.1	20	9.6	12	-3.4	11.8	25.1
Transmit Loss (dB)	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5
TX earth station antenna diameter (m)	9	9	9	9	4.5	4.5	9
TX earth station antenna gain (dBi)	53.2	53.2	53.2	53.2	47.2	47.2	53.2
TX earth station antenna EIRP (dBW)	75.8	70.7	60.3	62.7	41.3	56.5	75.8
Uplink Rain Loss (dB)	0	0	0	0	0	0	0
Free Space Loss (dB)	-199.7	-199.7	-199.7	-199.7	-199.7	-199.7	-199.7
Satellite G/T (dB/K)	3	3	3	3	3	3	3
Boltzmann's Constant (dBW/K-Hz)	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6	-228.6
C/N uplink (dB)	32.1	28.3	23.7	27.6	23.2	26.3	32.1
C/I uplink (dB)	20.7	16.9	12.3	16.2	11.8	14.9	20.7
C/N+I uplink (dB)	20.4	16.6	12.0	15.9	11.5	14.6	20.4
Downlinks:							
Satellite Carrier EIRP (dBW)	39	37.8	31.9	30.4	13.4	25.5	39.0
Interference bandwidth (MHz)	36	27	7	5	0.100	1.600	36
Satellite EIRP density (dBW/4KHz)	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54	-0.54
Downlink Rain Loss (dB)	0	0	0	0	0	0	0
Free Space Loss (dB)	-195.8	-195.8	-195.8	-195.8	-195.8	-195.8	-195.8
RX earth station antenna diameter (m)	3.8	3.8	3.8	3.8	3.8	3.8	3.8
RX earth station antenna G/T (dB/K)	22.2	22.2	22.2	22.2	22.2	22.2	22.2
C/N downlink (dB)	18.4	18.4	18.4	18.4	18.4	18.4	18.4
C/I downlink (dB)	18.2	18.2	18.2	18.2	18.2	18.2	18.2
C/N+I downlink (dB)	15.3	15.3	15.3	15.3	15.3	15.3	15.3
C/N system (dB)	18.2	18.0	17.3	17.9	17.2	17.8	18.2
C/I system (dB)	16.2	14.5	11.3	14.1	10.9	13.2	16.2
C/N+I system (dB)	14.1	12.9	10.3	12.6	10.0	11.9	14.1

Table 14: Ku-band & C-band Link Budgets for TV/FM

	Ku-band	C-band
Parameter	Typical TV/FM link	Typical TV/FM link
Carrier designation	36M0F3F	36M0F3F
Uplinks:		
Transmit Power (dBW)	22	25
Transmit Loss (dB)	-1	-0.5
TX earth station antenna diameter (m)	6.1	9
TX earth station antenna gain (dBi)	57.3	53.5
TX earth station antenna EIRP (dBW)	78.3	78.0
Uplink Rain Loss (dB)	-2	-1
Free Space Loss (dB)	-207	-199.7
Satellite G/T (dB/K)	3	1.3
Bandwidth (dB-Hz)	75.6	75.6
Boltzmann's Constant (dBW/K-Hz)	-228.6	-228.6
C/N, uplink (dB)	25.4	31.7
Downlinks:		
Satellite Carrier EIRP (dBW)	48.2	42
Downlink Rain Loss (dB)	-3	-0.5
Free Space Loss (dB)	-205.4	-195.8
RX earth station antenna diameter (m)	1.2	3.8
RX earth station antenna G/T (dB/K)	21.7	22.1
C/N downlink (dB)	14.5	20.8
C/I ASI (dB)	17.3	17.6
C/N Total (dB)	12.7	15.9
Required (dB)	11	11
Margin (dB)	1.7	4.9

Table 15: Typical 17/24 GHz Link Budgets

Carrier designation	1M20G1W	5M50G1W
Required bandwidth (MHz)	1.2	5.5
C/N required (dB)	4.7	1.3
Faded system margin (dB)	0.5	0.5
Uplink		
Transmit Power (dBW)	4	10.5
TX earth station antenna diameter (m)	9	9
TX earth station antenna gain (dBi)	65.6	65.6
TX earth station input power density (dBW/MHz)	3.2	3.1
TX earth station antenna EIRP (dBW)	69.6	76.1
Uplink Rain Loss (dB)	0	0
Uplink Path Loss (dB)	-212.2	-212.2
Boltzmann's Constant (dBW/K-Hz)	-228.6	-228.6
Satellite G/T (dB/K)	-8	-8
C/N uplink (dB)	17.2	17.1
C/I X-pol uplink (dB)	30	30
Downlink		
Satellite Carrier EIRP (dBW)	29.6	31.6
RX earth station antenna diameter (m)	0.95	1.5
RX earth station antenna G/T (dB/K)	22.9	26.9
Downlink path loss (dB)	-209.1	-209.1
C/N downlink clear-sky (dB)	11.3	10.6
Min C/N down (dB)	6.2	2.6
C/I ASI (dB)	12.2	9.5
C/I Total (dB)	12.0	9.5
Rain margin to min C/N down (dB)	5.0	8.0

5 Power Flux Density Limits

Section 25.208 of the Commission's Rules specifies the maximum allowed pfd in C-band. Table 16 shows the pfd and margin computations. The margins are all positive.

Table 16: C-band pfd and margin values

Elevation angle, deg	5.00	10.00	15.00	20.00	25.00	Max. EIRP
Max. EIRP, dBW	42.1	42.1	42.1	42.1	42.1	42.1
EIRP at elevation angle, dBW	35.7	36.0	36.3	36.7	37.8	42.1
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.0	-162.9	-162.8	-162.5
25.208 PFD limit	-152.0	-149.5	-147.0	-144.5	-142.0	-142.0
Digital Carriers						
Carrier bandwidth, MHz	36.0	36.0	36.0	36.0	36.0	36.0
PFD, dBW/m2/4KHz	-167.1	-166.7	-166.3	-165.8	-164.6	-159.9
Margin, dB, relative to 25.208	15.1	17.2	19.3	21.3	22.6	17.9
Analog TV/FM (2 MHz spreading)						
Carrier bandwidth, MHz	2.0	2.0	2.0	2.0	2.0	2.0
PFD, dBW/m2/4KHz	-154.5	-154.2	-153.7	-153.3	-152.0	-147.4
Margin, dB, relative to 25.208	2.5	4.7	6.7	8.8	10.0	5.4

* The maximum EIRP values shown are in H-pol. The maximum EIRP values in V-pol are 0.4 dB lower.

No U.S. operating authority is being sought for the 17/24 GHz payload, but SES-3 complies with Sections 25.208(c) and 25.208(w) of the Commission's Rules, which specifies the maximum allowable pfd for the 17/24 GHz band. Table 17 shows the pfd levels and margin computations, and the margins are all positive.

Table 17: 17/24 GHz band pfd and margin values

Elevation angle, deg	5	10	15	20	25	Max. EIRP
Max. EIRP, dBW	33.6	33.6	33.6	33.6	33.6	33.6
EIRP at elevation angle, dBW	32.5	32.5	32.6	32.7	32.8	33.6
Minimum spreading loss, dB/m2	-163.3	-163.2	-163.0	-162.9	-162.8	-162.4
25.208 pfd limit (17.3-17.7 GHz), dBW/m2/MHz	-121	-121	-121	-121	-121	-121
25.208 pfd limit (17.7-17.8 GHz), dBW/m2/MHz	-115	-115	-115	-115	-115	-115

Carrier bandwidth, MHz	1.2	1.2	1.2	1.2	1.2	1.2
pfd, dBW/m2/MHz	-131.6	-131.4	-131.2	-131.0	-130.8	-129.6
pfd, dBW/m2/100 kHz	-141.6	-141.4	-141.2	-141.0	-140.8	-139.6
Margin (17.3-17.7 GHz), dB	10.6	10.4	10.2	10.0	9.8	8.6
Margin (17.7-17.8 GHz), dB	16.6	16.4	16.2	16.0	15.8	14.6

6 Cessation of Emissions

Each TWTA is commandable to apply or remove RF drive of the associated amplifier as required under § 25.207. Each TWTA can also be commanded on and off, although they are normally powered for the entire mission, after the satellite arrives on station.

7 Interference Analysis

Annex 2 shows the results of an interference analysis for C- and Ku-band operations in a 2-degree spacing environment. Using C/I metrics, the analysis shows that the interference can be restricted to no more than 6% of the noise plus interference at threshold.[2]

Even though no U.S. operating authority is being sought for the 17/24 GHz payload, information is provided here to demonstrate that the payload is capable of complying with Commission rules for operation in a four-degree spacing environment. Specifically, Annex 2 shows that the payload complies with the pfd and off-axis EIRP density limits found in § 25.208(w) and § 25.223 of the Commission's rules, which together form the basis of the FCC's four-degree spacing environment for 17/24 GHz BSS. As requested by § 25.140(b)(3), Annex 2 also provides C/I and C/(N+I) estimates of the SES-3 17/24 GHz carriers when interfered with by a hypothetical adjacent satellite system operating at 4° orbital separation, and operating at the maximum satellite EIRP density allowed by the FCC. Additionally, a licensed satellite network assigned to an orbital location with slightly less than 4° spacing is considered and analyzed in the same fashion as the hypothetical satellite above. In this conservative model the C/N margin is seen to be positive (approximately 5 dB) in the two typical cases. Annex 2 also includes information demonstrating that the 17/24 GHz payload on SES-3 would comply with the requirements in § 25.264 to facilitate reverse-band operation with the DBS service.

8 Maximum Theoretical Operation Levels

SES-3 will be operated consistently with applicable coordination agreements with adjacent satellites. In any case, in the Ku-band frequencies, the downlink EIRP density of the SES-3 digital carriers will not exceed -19 dBW/Hz; and the input power density of the uplink digital carriers of

[2] The interference analysis is done assuming digital wanted and interfering carriers. Analog carriers will be coordinated on a case-by-case basis, and are not addressed here.

earth stations operating with SES-3 will not exceed -47 dBW/Hz. In the C-band frequencies, the downlink EIRP density of the SES-3 digital carriers will not exceed -30 dBW/Hz; and the input power density of the uplink digital carriers of earth stations operating with SES-3 will not exceed -38.7 dBW/Hz.

9 Mitigation of Orbital Debris

This section provides the information required under Section 25.114(d)(14) of the Commission's Rules.

§ 25.114(d)(14)(i): SES has assessed and limited the amount of debris released in a planned manner during normal operations of SES-3. During the satellite ascent, after separation from the launcher, no debris was generated. As with all recent SES satellite launches, all deployments were conducted using pyrotechnic devices designed to retain all physical debris. No debris is generated during normal on-station operations, and the spacecraft will be in a stable configuration. On-station operations require stationkeeping within the +/- 0.05 degree N-S and E-W control box, thereby ensuring adequate collision avoidance distance from other satellites in geosynchronous orbit. In the event that co-location of this and another satellite is required, use of the proven Inclination-Eccentricity (I-E) separation method can be employed. This strategy is presently in use by SES to ensure proper operation and safety of multiple satellites within one orbital box.

SES has also assessed and limited the probability of the space station becoming a source of orbital debris by collisions with small debris or meteoroids that could cause loss of control and prevent post-mission disposal. The design of SES's recent spacecraft locates all sources of stored energy within the body of the structure, which provides protection from small orbital debris. SES requires that spacecraft manufacturers assess the probability of micrometeorite damage that can cause any loss of functionality. This probability is then factored into the ultimate spacecraft probability of success. Any significant probability of damage would need to be mitigated in order for the spacecraft design to meet SES's required probability of success of the mission. SES has taken steps to limit the effects of any collisions through shielding, the placement of components, and the use of redundant systems.

§ 25.114(d)(14)(ii): SES has assessed and limited the probability of accidental explosions during and after completion of mission operations. As part of the Safety Data Package submission for SES spacecraft, an extensive analysis is completed by the spacecraft manufacturer, reviewing each potential hazard relating to accidental explosions. A matrix is generated indicating the worst-case effect, the hazard cause, and the hazard controls available to minimize the severity and the probability of occurrence. Each subsystem is analyzed for potential hazards, and the Safety Design Package is provided for each phase of the program running from design phase, qualification, manufacturing and operational phase of the spacecraft. Also, the spacecraft manufacturer generates a Failure Mode Effects and Criticality Analysis for the spacecraft to identify all potential mission failures. The risk of accidental explosion is included as part of this analysis. This analysis indicates failure modes, possible causes, methods of detection, and compensating features of the spacecraft design.

The design of the SES-3 spacecraft is such that the risk of explosion is minimized both during and after mission operations. In designing and building the spacecraft, the manufacturer took steps to ensure that debris generation will not result from the conversion of energy sources on board the satellite into energy that fragments the satellite. All propulsion subsystem pressure vessels, which have high margins of safety at launch, have even higher margins in orbit, since use of propellants and pressurants during launch decreases the propulsion system pressure. Burst tests are performed on all pressure vessels during qualification testing to demonstrate a margin of safety against burst. Bipropellant mixing is prevented by the use of valves that prevent backwards flow in propellant and pressurization lines. All pressures, including those of the batteries, will be monitored by telemetry.

At the end of operational life, after the satellite has reached its final disposal orbit, all on-board sources of stored energy will be depleted or secured, excess propellant will be vented, pressure vessels will be relieved, and the batteries will be discharged.

§ 25.114(d)(14)(iii): SES has assessed and limited the probability of the space station becoming a source of debris by collisions with large debris or other operational space stations. Specifically, SES has assessed the possibility of collision with satellites located at, or reasonably expected to be located at, the requested orbital location or assigned in the vicinity of that location.

Regarding avoidance of collisions with controlled objects, in general, if a geosynchronous satellite is controlled within its specified longitude and latitude stationkeeping limits, collision with another controlled object (excluding where the satellite is collocated with another object) is the direct result of that object entering the allocated space.

The instant application seeks authority for operation of SES-3 at the 103° W.L. orbital location, where it will replace SES Americom's AMC-1 spacecraft. SES expects to request authority to allow it to relocate AMC-1 once SES-3 is operational at 103° W.L. SES is not aware of any other FCC- or non-FCC licensed spacecraft that are operational or planned to be deployed at 103° W.L. or to nearby orbital locations such that there would be an overlap with the requested stationkeeping volume of SES-3.

SES uses the Space Data Center (SDC) system from the Space Data Association to monitor the risk of close approach of its satellites with other objects. Any close encounters (separation of less than 10 km) are flagged and investigated in more detail. If required, avoidance maneuvers are performed to eliminate the possibility of collisions.

During any relocation, the moving spacecraft is maneuvered such that it is at least 30 km away from the synchronous radius at all times. In most cases, much larger deviation from the synchronous radius is used. In addition, the SDC system is used to ensure no close encounter occurs during the move. When de-orbit of a spacecraft is required, the initial phase is treated as a satellite move, and the same precautions are used to ensure collision avoidance.

§ 25.114(d)(14)(iv): Post-mission disposal of the satellite from operational orbit will be accomplished by carrying out maneuvers to a higher orbit. The upper stage engine remains part of the satellite, and there is no re-entry phase for either component. The fuel budget for elevating the satellite to a disposal orbit is included in the satellite design. SES plans to maneuver SES-3 to a disposal orbit with a minimum perigee of 273.6 km above the normal operational altitude. The proposed disposal orbit altitude complies with the altitude resulting from application of the IADC formula based on the following calculation:

Area of the satellite (average aspect area): 44 m^2

Mass of the spacecraft: 1378 kg

C_R (solar radiation pressure coefficient): 1.21

Therefore the Minimum Disposal Orbit Perigee Altitude, as calculated under the IADC formula is:

36,021 km + ($1000 \times C_R \times A/m$) = 36059.6 km, or 273.6 km above the GSO arc (35,786 km)

SES intends to reserve 18.0 kg of fuel in order to account for post-mission disposal of SES-3. SES has assessed fuel-gauging uncertainty and has provided an adequate margin of fuel reserve to address the assessed uncertainty.

ANNEX 1

Coverage Maps

Figure A1.1 C-band, Receive beam, V-pol (CRV)
G/T max: 5.3 dB/K
Antenna gain max: 31.9 dBi

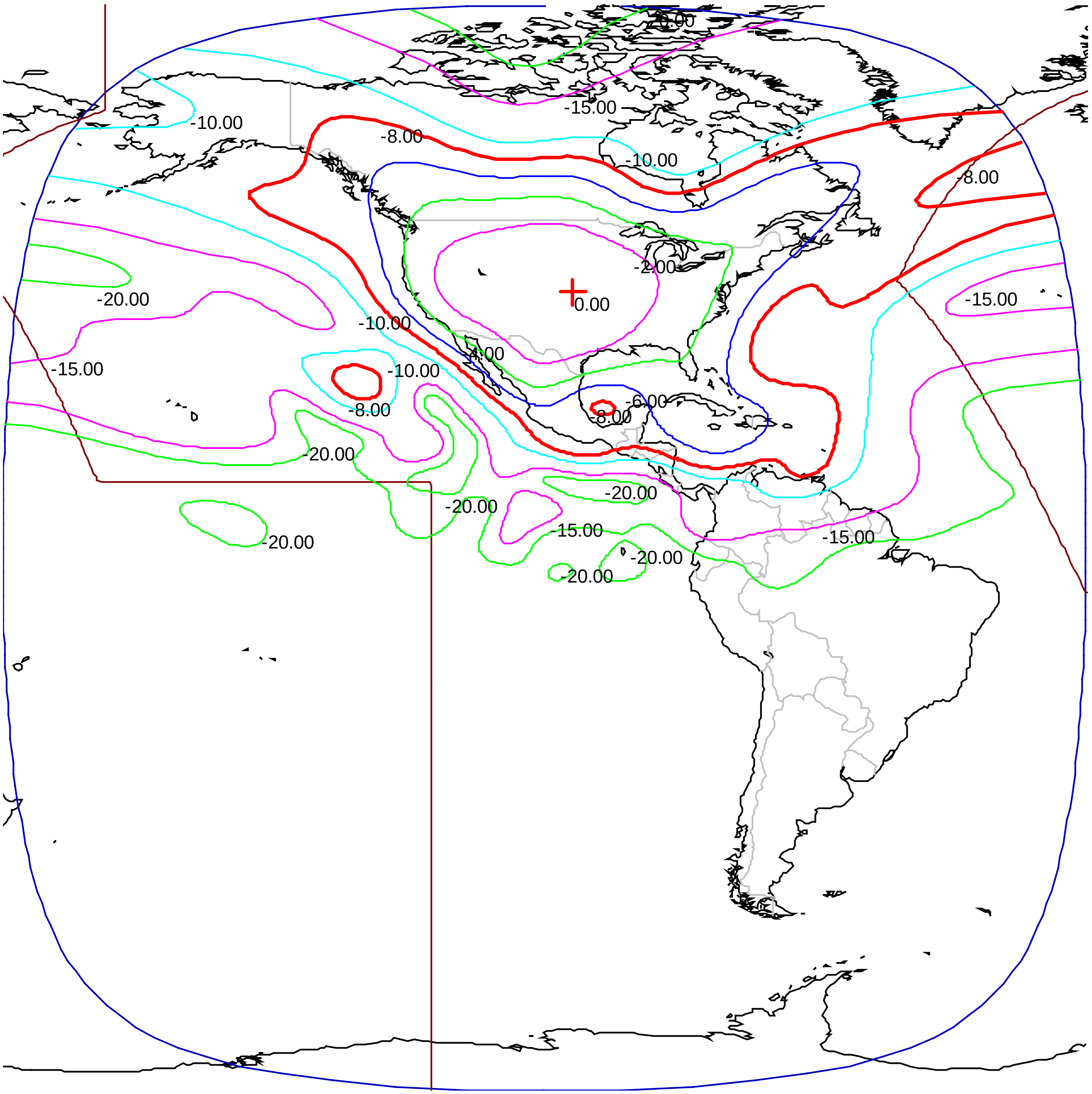


Figure A1.2 C-band, Transmit beam, V-pol (CTV)
EIRP max: 42.1 dBW
Antenna gain max: 31.2 dBi

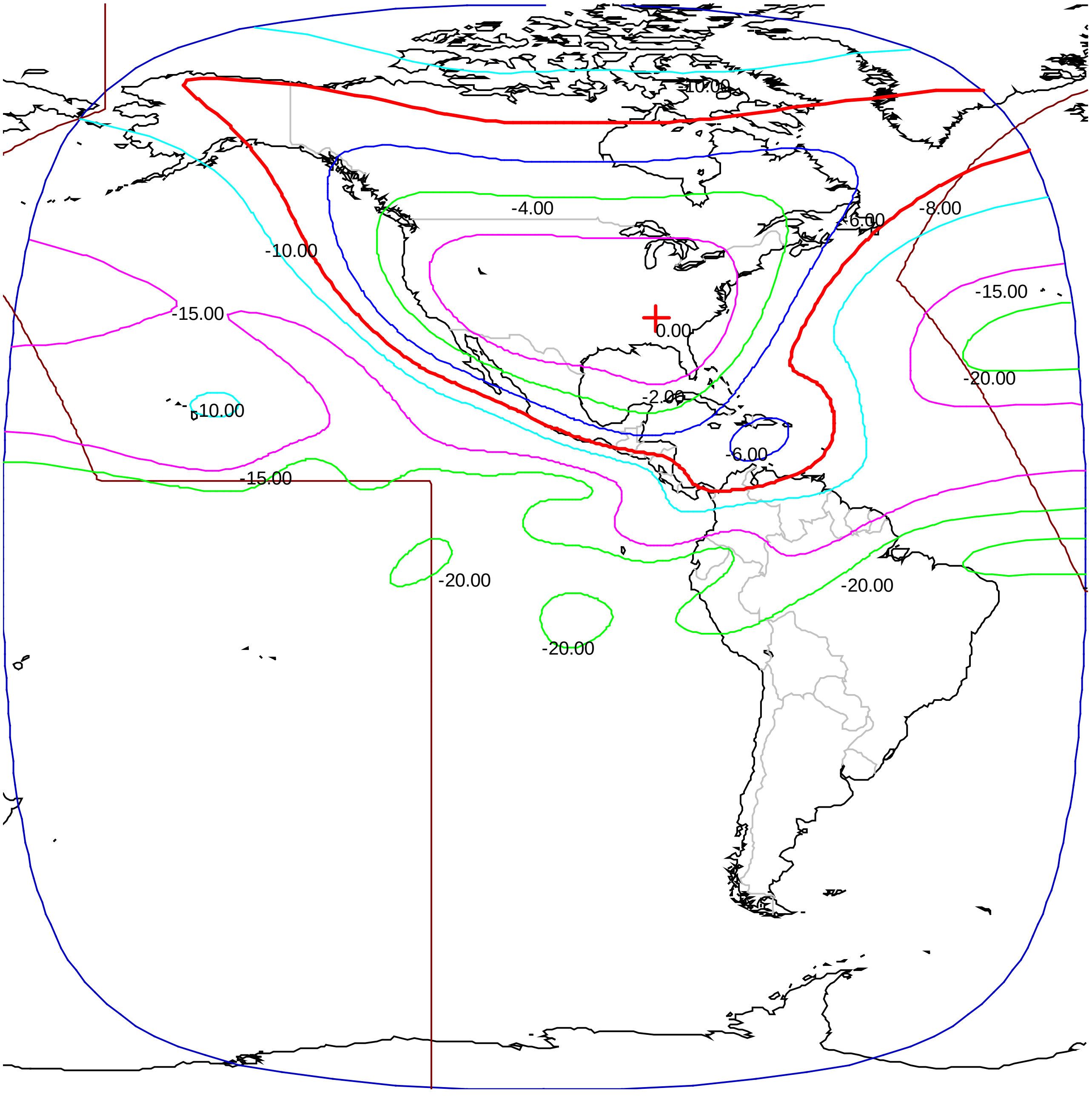


Figure A1.3 C-band, Receive beam, H-pol (CRH)
G/T max: 5.0 dB/K
Antenna gain max: 31.5 dBi

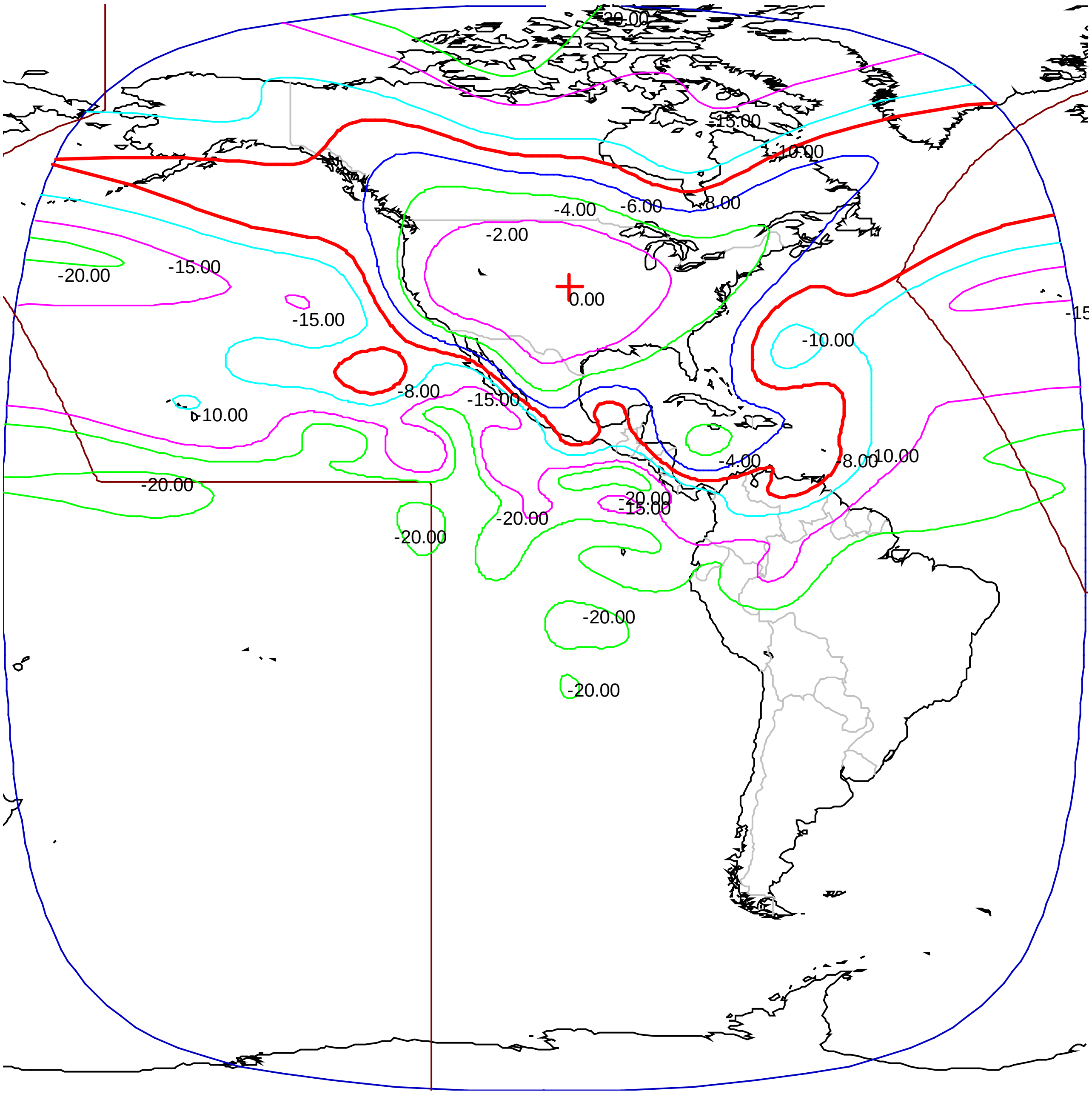


Figure A1.4 C-band, Transmit beam, H-pol (CTH)
EIRP max: 42.1
Antenna gain max: 31.3 dBi

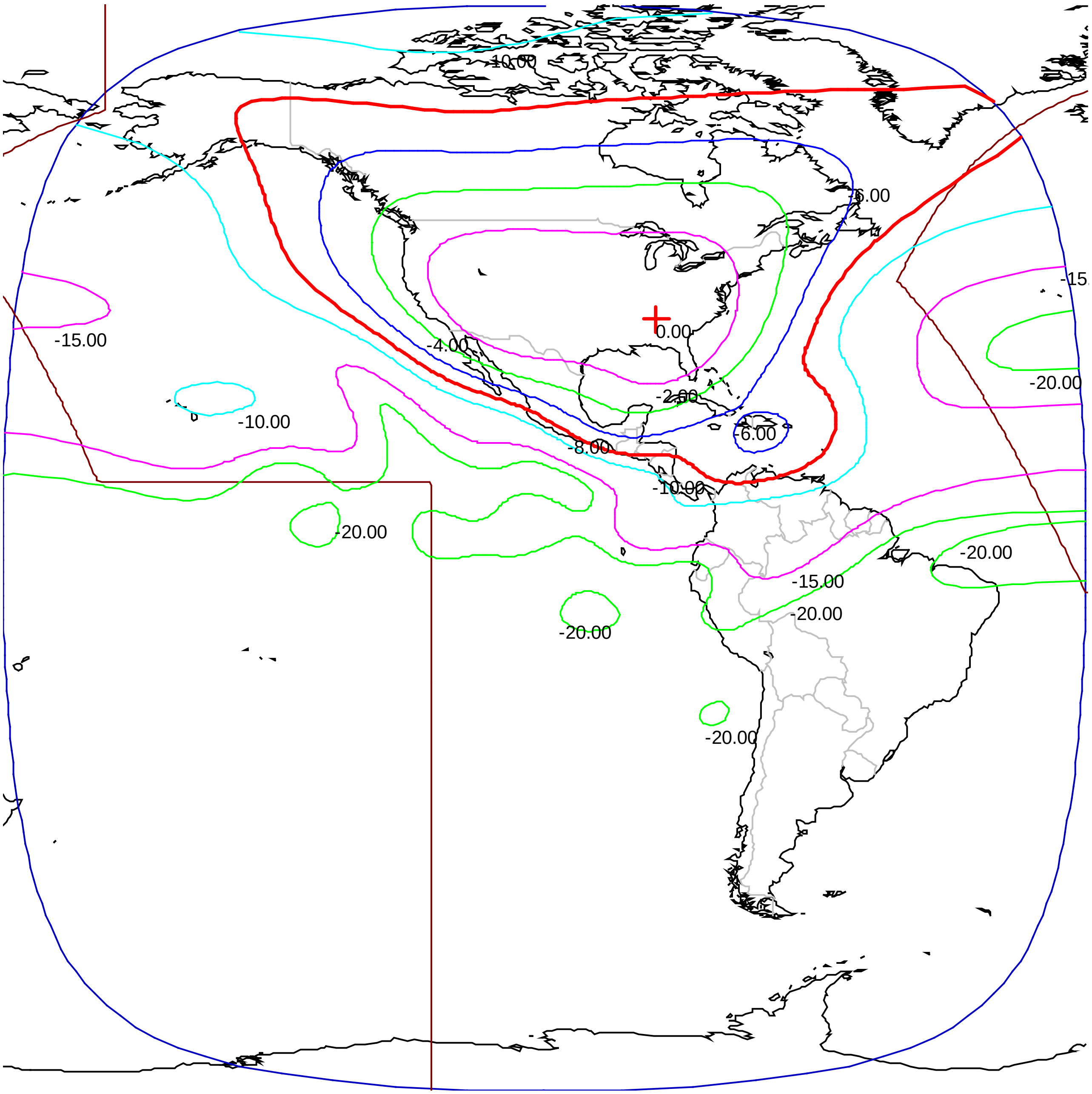


Figure A1.5 Ku-band, Receive beam, H-pol (KRH)
G/T max: 7.0 dB/K
Antenna gain max: 34.3 dBi

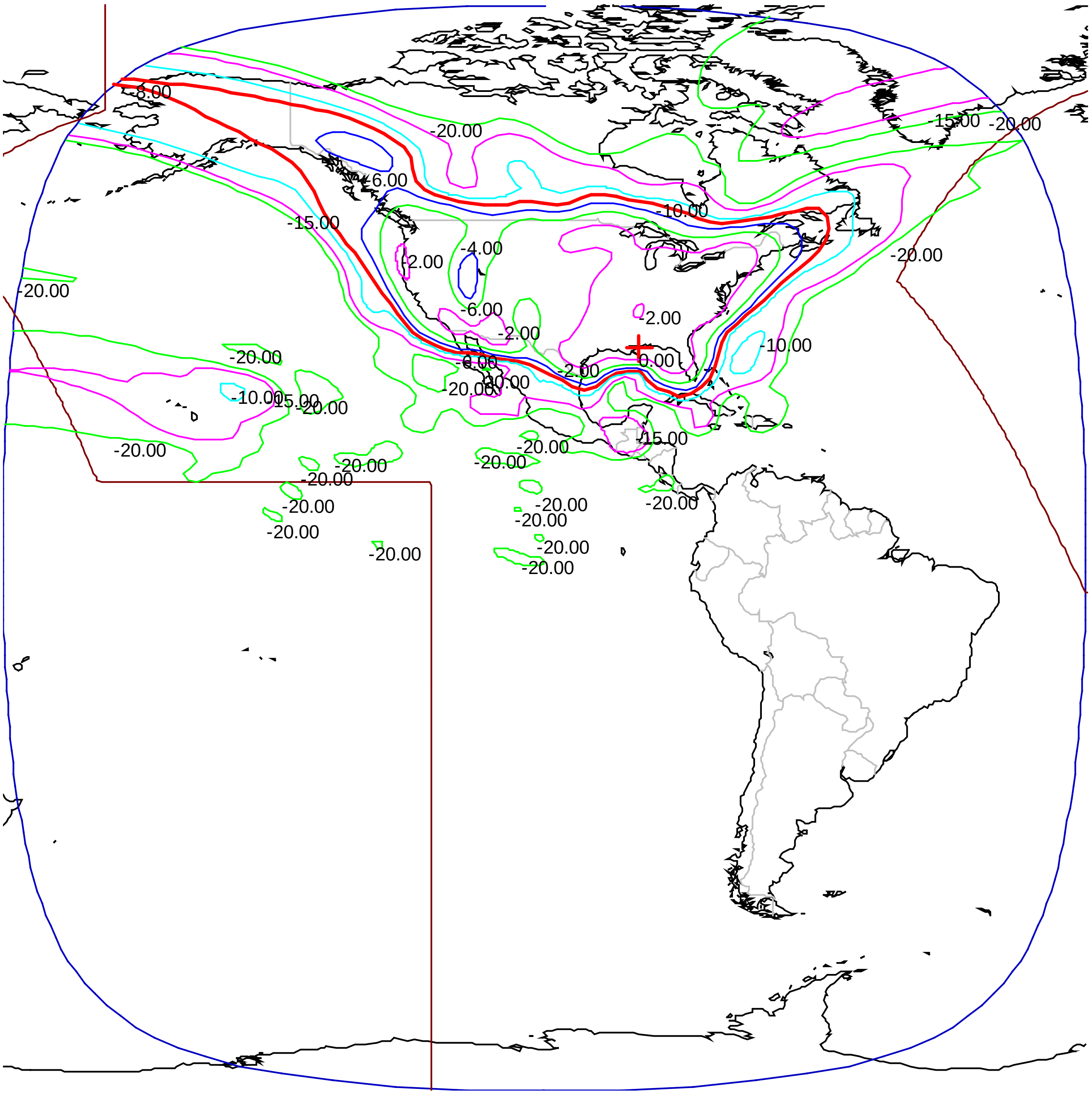


Figure A1.6 Ku-band, Transmit beam, H-pol (KTH)
EIRP max: 53.3 dBW
Antenna gain max: 36.1 dBi

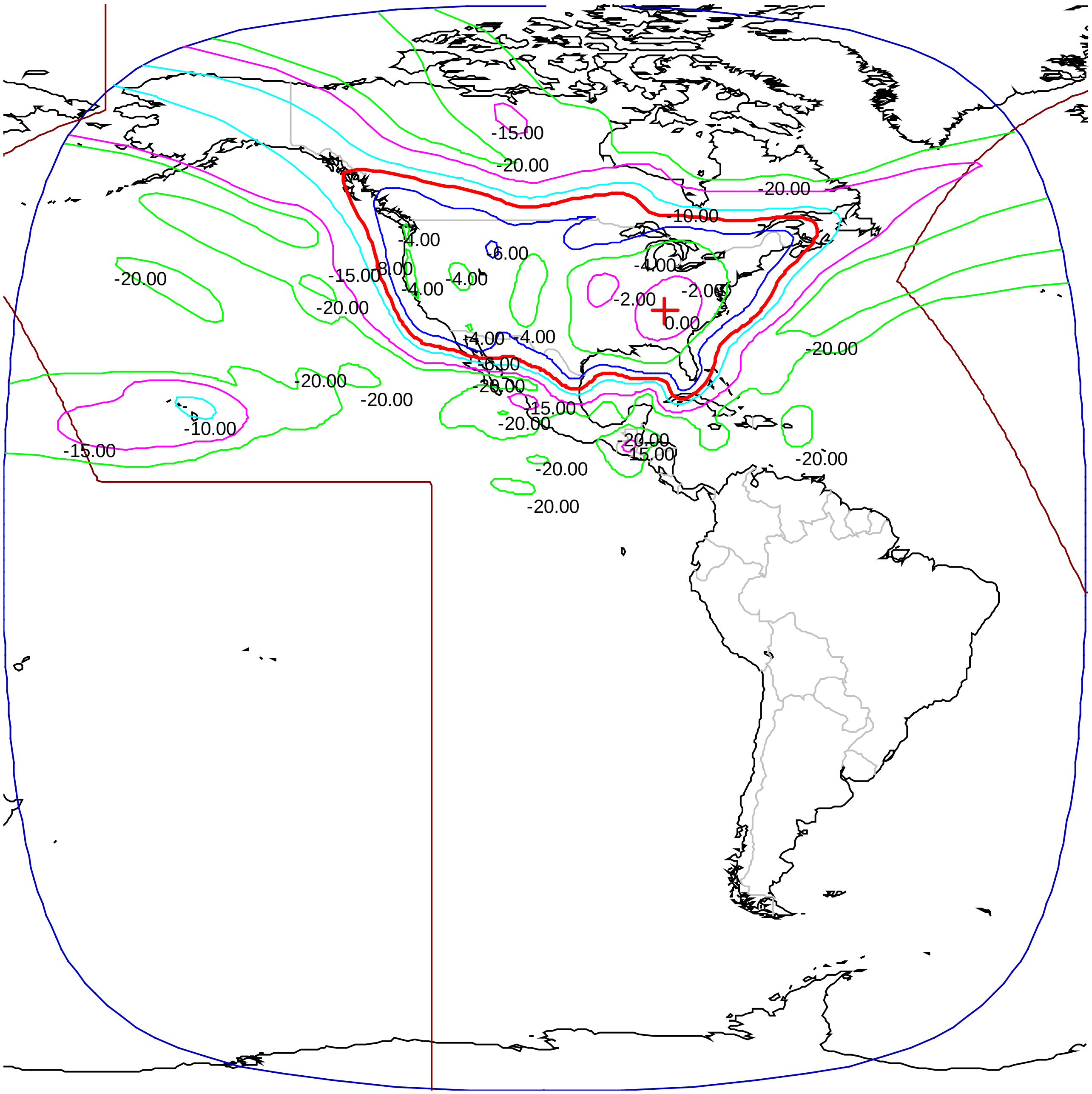


Figure A1.7 Ku-band, Receive beam, V-pol (KRV)
G/T max: 7.0 dB/K
Antenna gain max: 34.5 dBi

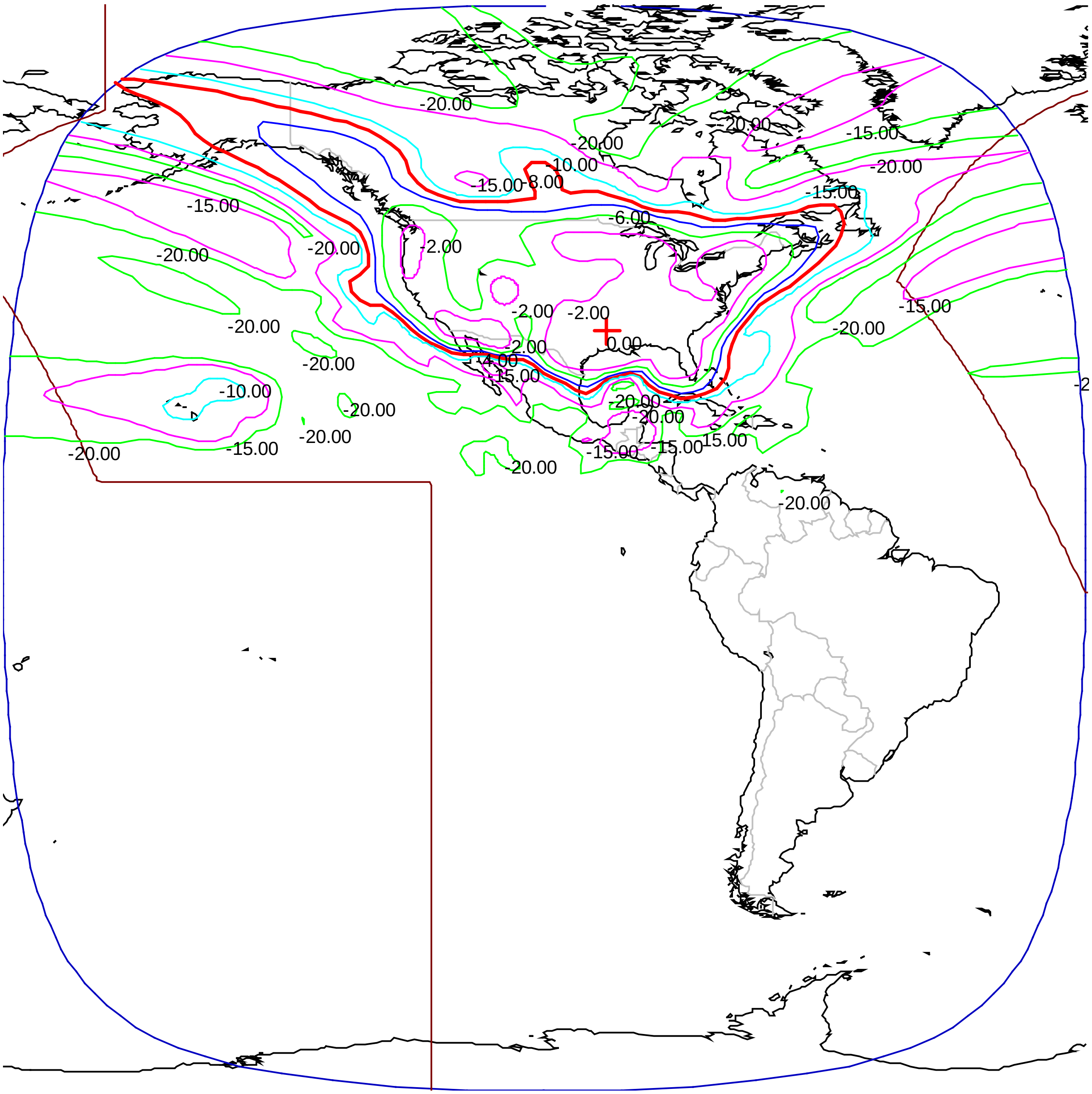


Figure A1.8 Ku-band, Transmit beam, V-pol (KTV)
EIRP max: 52.5 dBW
Antenna gain max: 34.9 dBi

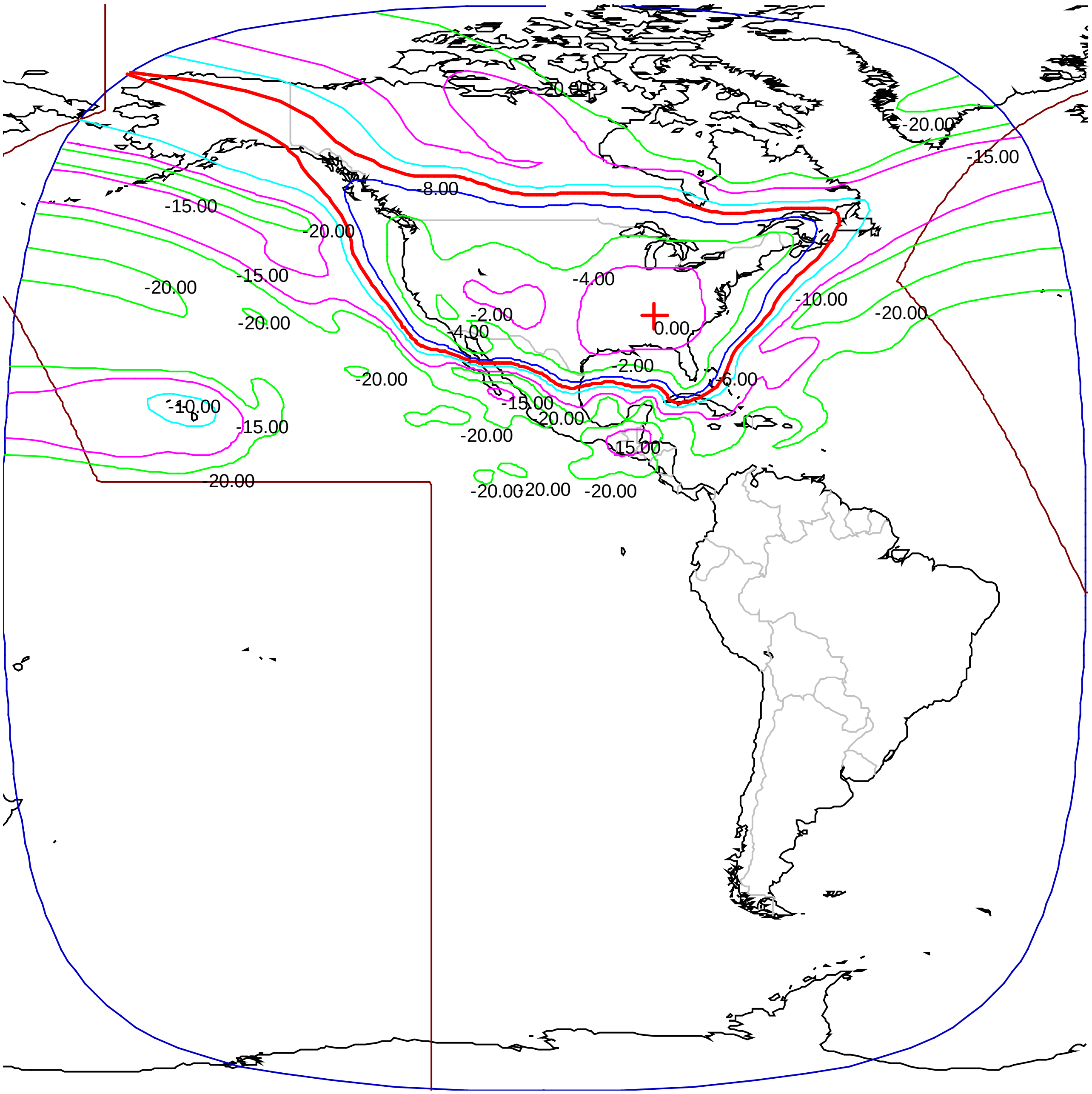


Figure A1.9 17/24 GHz band, Receive beam, (KAR)
G/T max: -7.4 dB/K
Antenna gain max: 23.5 dBi

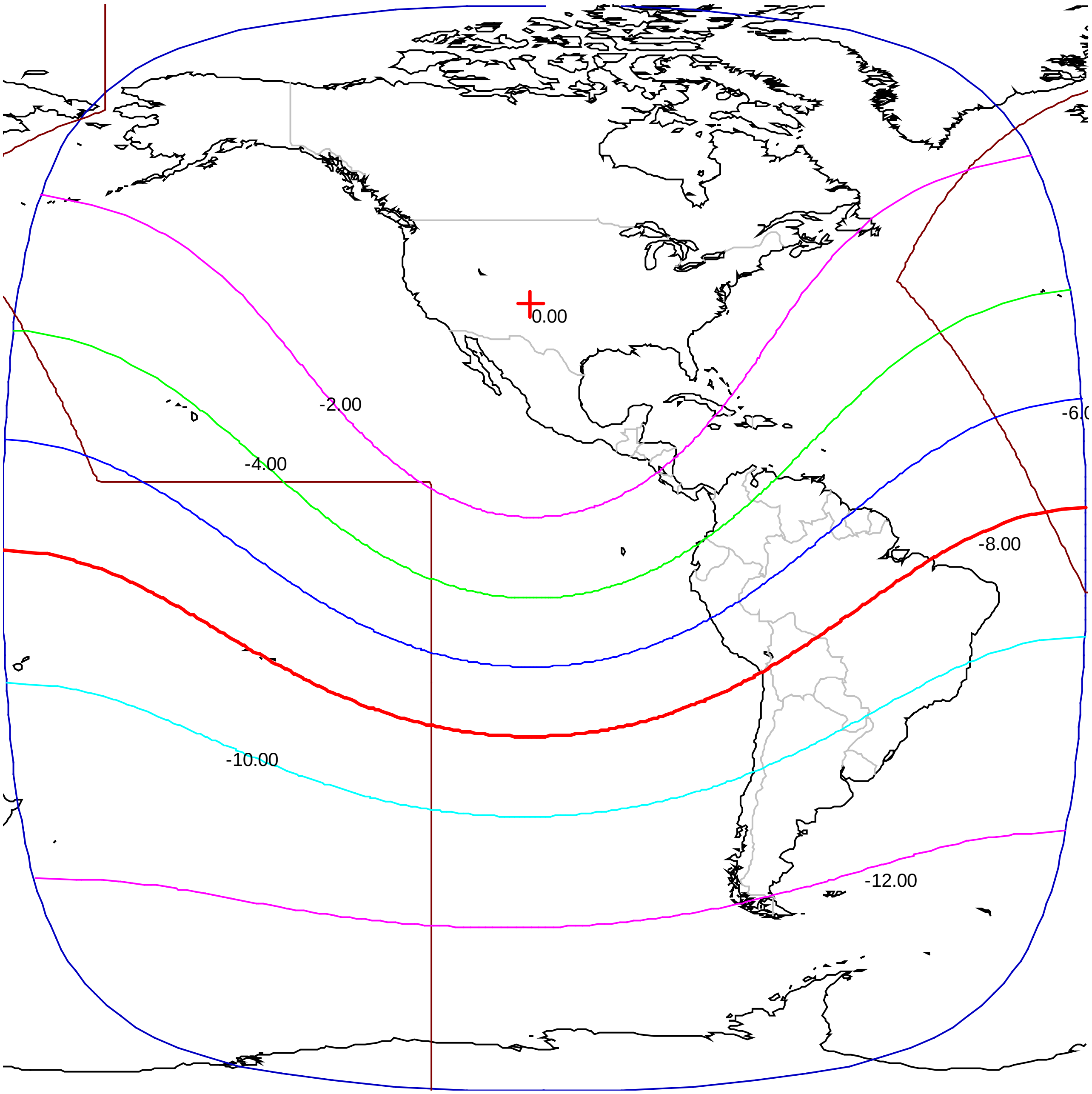
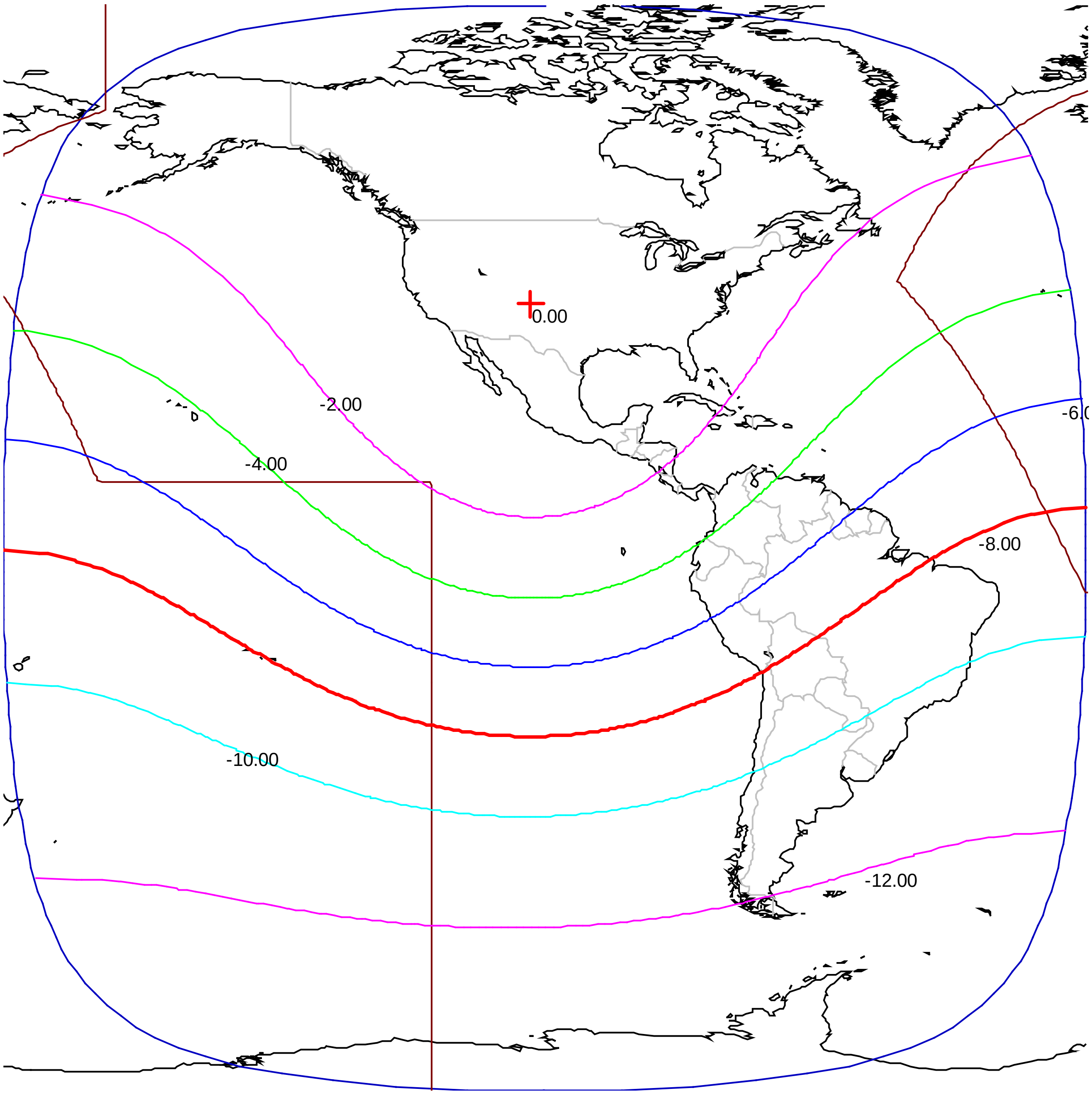


Figure A1.10 17/24 GHz band, Transmit beam, LHCP/RHCP (KATL/KATR)
EIRP max: 33.6 dB/K
Antenna gain max: 23.3 dBi



ANNEX 2

Interference Analysis in support of SES-3

1 C-band & Ku-band Two Degree Spacing Analysis

The operational C-band satellites adjacent to the 103° W.L. position are SES Americom's SES-1 at 101° W.L. and AMC-18, which is operated by SES Americom's subsidiary SES Satellites (Gibraltar) Limited, at 104.95° W.L. The operational Ku-band satellites adjacent to the 103° W.L. position are SES Americom's SES-1 at 101° W.L. and SES Americom's AMC-15 at 105.05° W.L. SES-3 will take the place of SES Americom's AMC-1 spacecraft, which is currently operating at the 103° W.L. position. Operations of SES-3 at this location will conform to the existing coordination arrangements SES Americom has with adjacent satellite networks. SES Americom has coordinated AMC-1 at 103°W.L. with its adjacent satellites: AMC-18, AMC-15 and SES-1.

Satellite transponders of SES-3 will be operated at power no higher than that allowed by the FCC, or generally coordinated with adjacent satellite operators.

The following analysis will demonstrate that the SES-3 network is compatible with a co-coverage, co-frequency satellite, spaced two degrees away. This analysis has been performed for digital signals in both networks. Analog TV/FM signals are coordinated on a case-by-case basis with nearby spacecraft, and are therefore not addressed in this analysis. Digital signals are more robust and operate typically down to much lower C/N ratios than analog signals. They are therefore more tolerant of interference, improving the ability to coordinate at 2º orbit spacing.

1.1 Uplink analysis

This scenario addresses uplink interference between digital carriers in both the wanted and victim satellite networks. The analysis assumes that the transponder gains can be matched to give similar wanted input signal spectral density levels at the two satellites. The uplink C/I will be a function of the difference between the gain of the transmitting earth stations at boresight and the gain at the off-axis (topocentric) angle.

1.1.1 Ku-band uplink C/I estimates

The topocentric angle for a geocentric separation of 2º is approximately 2.2º. The sidelobe envelope at 2.2º off boresight for an antenna that meets the 29-25 log(θ) reference pattern is 20.4 dBi. The boresight gain will be a function of the size of the transmitting earth station. The following Table A2.1 lists the boresight gain, the off-axis gain and the corresponding C/I that would result in the interference scenario with AMC-15 having a G/T disadvantage of -2.4 dB/K.

Table A2.1: Ku-band uplink C/I for two degree geocentric spacing

Antenna size (m)	On-axis gain (dBi)	Off-axis gain	C/I (dB)
1.2	43.2	20.4	20.4
1.8	46.7	20.4	23.9
2.4	49.2	20.4	26.4
4.5	54.7	20.4	31.8
6	57.2	20.4	34.3

Assuming that the minimum (*i.e.*, threshold) C/N for a digital service is 8 dB, the effect of the C/I (20.35 dB) from the 1.2 meter earth station in Table A2.1 above would only degrade the C/N by 0.25 dB, equivalent to an increase of 5.82% in the victim's system noise temperature. This is less than the ITU coordination trigger criteria; *i.e.*, internationally, if a 6% increase in noise temperature is not exceeded, then coordination is not needed between the concerned networks.

1.1.2 C-band uplink C/I estimates

The topocentric angle for a geocentric separation of 2º is approximately 2.2º. The sidelobe envelope at 2.2º off boresight for an antenna that meets the 29-25 log(θ) reference pattern is 20.44 dBi. The boresight gain will be a function of the size of the transmitting earth station. The following Table A2.2 lists the boresight gain, the off-axis gain and the corresponding C/I that would result in the interference scenario with AMC-18 having a G/T disadvantage of -0.82 dB/K:

Table A2.2: C-band uplink C/I for two-degree geocentric spacing

Antenna size (m)	On-axis gain (dBi)	Off-axis gain	C/I (dB)
3.8	46.0	20.4	24.8
4.5	47.5	20.4	26.3
6.0	50.0	20.4	28.8
7.5	51.9	20.4	30.7
9.0	53.5	20.4	32.3

Assuming that the minimum (*i.e.*, threshold) C/N for a digital service is 8 dB, the effect of the C/I (24.78 dB) from the 3.8 meter earth station in Table A2.2 above would only degrade the C/N by 0.09 dB, equivalent to an increase of 2.1% in the victim's system noise temperature. This is less than the ITU coordination trigger criteria; *i.e.*, internationally, if a 6% increase in noise temperature is not exceeded, then coordination is not needed between the concerned networks.

1.2 Downlink analysis

This scenario addresses downlink interference between digital carriers in both the wanted and victim satellite networks. For the first case, the analysis assumes that the EIRP of the two satellites are similar. For the second case, the SES-1 and AMC-18 peak EIRP values (for Ku-band and C-band respectively) are used against the SES-3 values. There is a differential of -1 dB in EIRP of SES-1 from SES-3 in Ku-band and a -1 dB differential in EIRP of AMC-18 from SES-3 in C-band. Similar to the uplink, the downlink C/I will be a function of the difference between the gain of the receiving earth stations at boresight and the gain at the off-axis angle, as well as any difference in EIRP between the two networks.

The topocentric angle for a geocentric separation of 2º is approximately 2.2º. The gain at 2.2º off boresight for an antenna that meets the 29-25 log(θ) reference pattern is 20.44 dBi. The boresight gain will be a function of the size of the receiving earth station.

1.2.1 Ku-band

The following tables list the boresight gain, the off-axis gain and the corresponding C/I that would result in this interference scenario, where the EIRP of the two networks is similar (Table A2.3) and where the EIRP of the two networks is different by 1 dB (Table A2.4):

Table A2.3: Ku-band downlink C/I for two-degree geocentric spacing EIRP of the wanted and adjacent satellites is the same

Antenna size (m)	On-axis gain (dBi)	Off-axis gain (dBi)	Off-axis discrimination (dB)	C/I (dB)
1.2	41.7	20.4	21.2	21.2
1.8	45.2	20.4	24.7	24.7
2.4	47.7	20.4	27.2	27.2
4.5	53.1	20.4	32.7	32.7
6	55.6	20.4	35.2	35.2

Table A2.4: Ku-band downlink C/I for two-degree geocentric spacing EIRP of adjacent satellite is 1 dB lower than SES-3

Antenna size (m)	On-axis gain (dBi)	Off-axis gain (dBi)	Off-axis discrimination (dB)	C/I (dB)
1.2	41.7	20.4	21.2	20.2
1.8	45.2	20.4	24.7	23.7
2.4	47.7	20.4	27.2	26.2
4.5	53.1	20.4	32.7	31.7
6	55.6	20.4	35.2	34.2

Again, assuming that the minimum (*i.e.*, threshold) C/N for a digital service is 8 dB, the effect of the C/I (20.22 dB) into the 1.2 meter earth station in Table A2.4 above would only degrade the C/N by 0.25 dB, equivalent to an increase of 6.0% in the victim system's noise temperature. Although this is equal to the normal criteria of 6%, the victim's system link degradation is still less than 0.5 dB, which is significantly less than the likely link margin.

1.2.2 C-band

The following tables list the boresight gain, the off-axis gain and the corresponding C/I that would result in this interference scenario, where the EIRP of the two networks is similar (Table A2.5) and where the EIRP of the two networks is different by 1 dB (Table A2.6):

Table A2.5: C-band downlink C/I for two-degree geocentric spacing EIRP of wanted and adjacent satellites is the same

Antenna size (m)	On-axis gain (dBi)	Off-axis gain (dBi)	Off-axis discrimination (dB)	C/I (dB)
3.8	42.1	20.4	21.6	21.6
4.5	43.5	20.4	23.1	23.1
6.1	46.2	20.4	25.7	25.7
7.5	48.0	20.4	27.5	27.5

Table A2.6: C-band downlink C/I for two-degree geocentric spacing EIRP of adjacent satellite is 1 dB lower than that of SES-3

Antenna size (m)	On-axis gain (dBi)	Off-axis gain (dBi)	Off-axis discrimination (dB)	C/I (dB)
3.8	42.1	20.4	21.6	20.6
4.5	43.5	20.4	23.1	22.1
6.1	46.2	20.4	25.7	24.7
7.5	48.0	20.4	27.5	26.5

Again, assuming that the minimum (*i.e.*, threshold) C/N for a digital service is 8 dB, the effect of the C/I (20.62 dB) into the 3.8 meter earth station in Table A2.6 above would only degrade the C/N by 0.23 dB, equivalent to an increase of 5.47% in the victim's system noise temperature. This is less than the ITU coordination trigger criteria; *i.e.*, internationally, if a 6% increase in noise temperature is not exceeded, then coordination is not needed between the concerned networks.

1.3 Additional examples of C/I estimates

Attached tables A2.7 to A2.14 show some examples of single-entry C/I analysis for typical carriers on the satellite networks. The analysis is performed for SES-1 at 101° W.L., but similar results apply to the 105° W.L neighbors also.

1.3.1 Ku-band

Table A2.7 shows uplink C/I analysis of SES-3 into the adjacent satellite (SES-1) in Ku-band. Table A2.8 shows uplink C/I analysis of the adjacent satellite (SES-1) into SES-3. This analysis considers a topocentric separation of 2.2°. The C/I values for the SES-1 satellite carriers are at least 22 dB.

Tables A2.9 and A2.10 show the downlink C/I analyses of SES-3 and SES-1. The C/I values of the SES-1 carriers are minimally about 17 dB.

1.3.2 C-band

Table A2.11 shows uplink C/I analysis of SES-3 into the adjacent satellite (SES-1) in C-band. Table A2.12 shows uplink C/I analysis of the adjacent satellite (SES-1) into SES-3. This analysis considers a topocentric separation of 2.2°. The minimum C/I values for the SES-1 satellite carriers are at least 16.7 dB.

Tables A2.13 and A2.14 show the downlink C/I analyses of SES-3 and SES-1. The C/I values of the SES-1 carriers are minimally about 23 dB.

Table A2.7: SES-3 into adjacent satellite uplink C/I – Ku-band

UPLINK C/I Analysis - SES into Adjacent

Ku-band	14250 MHz	***SES carriers***					
		Emission	36M0G7W	27M0G7W	6M95G1W	5M00G1W	1M60G1W	100KG1W
SES orbital position	-103.0	Bandwidth, MHz	36	27	6.95	5	1.6	0.1
Adj. orbital position	-101.0	Input power, dBW/Hz	-55.6	-54.3	-59.6	-58.1	-54.0	-52.0
Topocentric sep.	2.2 deg	Antenna size, m	6.1	6.1	3.7	3.7	1.8	1.8
		Antenna gain, dBi	57.3	57.3	53.0	53.0	46.7	46.7
		EIRP density, dBW/Hz	1.7	3.0	-6.6	-5.1	-7.3	-5.3
		Sidelobe gain, dBi	20.4	20.4	20.4	20.4	20.4	20.4
		Off-ax. EIRP dens, dBW/Hz	-35.1	-33.9	-39.1	-37.7	-33.6	-31.6

Adjacent satellite carriers

Emission	Bandwidth, MHz	Input power, dBW/Hz	Antenna size, m	Antenna gain, dBi	EIRP density, dBW/Hz	Sidelobe gain, dBi	Off-ax. EIRP dens, dBW/Hz	C/I	C/I	C/I	C/I	C/I	C/I
36M0G7W	36	-55.6	6.1	57.3	1.7	20.4	-35.1	36.9	35.6	40.9	39.4	35.4	33.3
27M0G7W	27	-54.3	6.1	57.3	3.0	20.4	-33.9	38.1	36.9	42.1	40.6	36.6	34.6
6M95G1W	6.95	-59.6	3.7	53.0	-6.6	20.4	-39.1	28.5	27.3	32.5	31.1	27.0	25.0
5M00G1W	5	-58.1	3.7	53.0	-5.1	20.4	-37.7	30.0	28.8	34.0	32.5	28.5	26.4
1M60G1W	1.6	-54.0	1.8	46.7	-7.3	20.4	-33.6	27.8	26.5	31.8	30.3	26.3	24.2
100KG1W	0.1	-52.0	1.8	46.7	-5.3	20.4	-31.6	29.8	28.6	33.8	32.4	28.3	26.3

Table A2.8: Adjacent satellite into SES-3 uplink C/I – Ku-band

UPLINK C/I Analysis - Adjacent into SES

Ku-band	14250 MHz
SES orbital position	-103.0
Adj. orbital position	-101.0
Topocentric sep.	2.2 deg

SES carriers

Emission	36M0G7W	27M0G7W	6M95G1W	5M00G1W	1M60G1W	100KG1W
Bandwidth, MHz	36	27	6.95	5	1.6	0.1
Input power, dBW/Hz	-55.6	-54.3	-59.6	-58.1	-54.0	-52.0
Antenna size, m	6.1	6.1	3.7	3.7	1.8	1.8
Antenna gain, dBi	57.3	57.3	53.0	53.0	46.7	46.7
EIRP density, dBW/Hz	1.7	3.0	-6.6	-5.1	-7.3	-5.3
Sidelobe gain, dBi	20.4	20.4	20.4	20.4	20.4	20.4
Off-ax. EIRP dens, dBW/Hz	-35.1	-33.9	-39.1	-37.7	-33.6	-31.6

Adjacent satellite carriers

Emission	Bandwidth, MHz	Input power, dBW/Hz	Antenna size, m	Antenna gain, dBi	EIRP density, dBW/Hz	Sidelobe gain, dBi	Off-ax. EIRP dens, dBW/Hz	C/I	C/I	C/I	C/I	C/I	C/I
36M0G7W	36	-50	6.1	57.3	7.3	20.4	-29.6	31.3	32.6	23.0	24.4	22.2	24.3
27M0G7W	27	-50	6.1	57.3	7.3	20.4	-29.6	31.3	32.6	23.0	24.4	22.2	24.3
6M95G1W	6.95	-50	3.7	53.0	3.0	20.4	-29.6	31.3	32.6	23.0	24.4	22.2	24.3
5M00G1W	5	-50	3.7	53.0	3.0	20.4	-29.6	31.3	32.6	23.0	24.4	22.2	24.3
1M60G1W	1.6	-50	1.8	46.7	-3.3	20.4	-29.6	31.3	32.6	23.0	24.4	22.2	24.3
100KG1W	0.1	-50	1.8	46.7	-3.3	20.4	-29.6	31.3	32.6	23.0	24.4	22.2	24.3

Table A2.9: SES-3 into adjacent satellite downlink C/I – Ku-band

DOWNLINK C/I Analysis - SES into Adjacent

Ku-band	11950 MHz
SES orbital position	-103.0
Adj. orbital position	-101.0
Topocentric sep.	2.2 deg

SES carriers

Emission	36M0G7W	27M0G7W	6M95G1W	5M00G1W	1M60G1W	100KG1W
Bandwidth, MHz	36	27	6.95	5	1.6	0.1
Carrier EIRP density, dBW/Hz	-26.1	-26.1	-30.1	-30.1	-30.1	-30.1
Carrier EIRP, dBW	49.5	48.3	38.4	36.9	32.0	19.9
Rx ES antenna size, m	1.2	1.2	1.8	1.8	1.2	6.0
Rx ES antenna gain, dBi	41.7	41.7	45.2	45.2	41.7	55.6
Sidelobe gain, dBi	20.4	20.4	20.4	20.4	20.4	20.4

Adjacent satellite carriers

Emission	Bandwidth, MHz	Carrier EIRP density, dBW/Hz	Carrier EIRP, dBW	Rx ES antenna size, m	Rx ES antenna gain, dBi	Sidelobe gain, dBi	C/I	C/I	C/I	C/I	C/I	C/I
36M0G7W	36	-26.1	49.5	1.8	45.2	20.4	24.7	24.7	28.7	28.7	28.7	28.7
27M0G7W	27	-26.1	48.3	2.4	47.7	20.4	27.2	27.2	31.2	31.2	31.2	31.2
6M95G1W	6.95	-30.1	38.4	1.2	41.7	20.4	17.2	17.2	21.2	21.2	21.2	21.2
5M00G1W	5	-30.1	36.9	1.8	45.2	20.4	20.7	20.7	24.7	24.7	24.7	24.7
1M60G1W	1.6	-30.1	32.0	1.8	45.2	20.4	20.7	20.7	24.7	24.7	24.7	24.7
100KG1W	0.1	-30.1	19.9	6.0	55.6	20.4	31.2	31.2	35.2	35.2	35.2	35.2

Table A2.10: Adjacent satellite into SES-3 downlink C/I – Ku-band

DOWNLINK C/I Analysis - Adjacent into SES

							SES carriers					
Ku-band	11950 MHz						Emission	36M0G7W	27M0G7W	6M95G1W	5M00G1W	1M60G1W	100KG1W
SES orbital position	-103.0						Bandwidth, MHz	36	27	6.95	5	1.6	0.1
Adj. orbital position	-101.0						Carrier EIRP density, dBW/Hz	-26.1	-26.1	-30.1	-30.1	-30.1	-30.1
Topocentric sep.	2.2 deg						Carrier EIRP, dBW	49.5	48.3	38.4	36.9	32.0	19.9
							Rx ES antenna size, m	1.2	1.2	1.8	1.8	1.2	6.0
							Rx ES antenna gain, dBi	41.7	41.7	45.2	45.2	41.7	55.6
							Sidelobe gain, dBi	20.4	20.4	20.4	20.4	20.4	20.4

Adjacent satellite carriers

Emission	Bandwidth, MHz	Carrier EIRP density, dBW/Hz	Carrier EIRP, dBW	Rx ES antenna size, m	Rx ES antenna gain, dBi	Sidelobe gain, dBi	**C/I**	**C/I**	**C/I**	**C/I**	**C/I**	**C/I**
36M0G7W	36	-26	49.6	1.8	45.2	20.4	21.2	21.2	20.7	20.7	17.2	31.1
27M0G7W	27	-26	48.3	2.4	47.7	20.4	21.2	21.2	20.7	20.7	17.2	31.1
6M95G1W	6.95	-26	42.4	1.2	41.7	20.4	21.2	21.2	20.7	20.7	17.2	31.1
5M00G1W	5	-26	41.0	1.8	45.2	20.4	21.2	21.2	20.7	20.7	17.2	31.1
1M60G1W	1.6	-26	36.0	1.8	45.2	20.4	21.2	21.2	20.7	20.7	17.2	31.1
100KG1W	0.1	-26	24.0	6.0	55.6	20.4	21.2	21.2	20.7	20.7	17.2	31.1

Table A2.11: SES-3 into adjacent satellite uplink C/I – C-band

UPLINK C/I Analysis - SES into Adjacent

C-band	6175 MHz
SES orbital position	-103.0
Adj. orbital position	-101.0
Topocentric sep.	2.2 deg

SES carriers

Emission	36M0G7W	6M95G1W	1M60G1W	100KG1W
Bandwidth, MHz	36	6.95	1.6	0.1
Input power, dBW/Hz	-50.5	-58.9	-50.2	-53.4
Antenna size, m	4.5	3.7	3.4	3.4
Antenna gain, dBi	47.4	45.7	45.0	45.0
EIRP density, dBW/Hz	-3.1	-13.1	-5.3	-8.4
Sidelobe gain, dBi	20.4	20.4	20.4	20.4
Off-ax. EIRP dens, dBW/Hz	-30.1	-38.4	-29.8	-33.0

Adjacent satellite carriers

Emission	Bandwidth, MHz	Input power, dBW/Hz	Antenna size, m	Antenna gain, dBi	EIRP density, dBW/Hz	Sidelobe gain, dBi	Off-ax. EIRP dens, dBW/Hz	C/I	C/I	C/I	C/I
36M0G7W	36	-50.5	4.5	47.4	-3.1	20.4	-30.1	27.0	35.3	26.7	29.9
6M95G1W	6.95	-58.9	3.7	45.7	-13.1	20.4	-38.4	16.9	25.3	16.7	19.8
1M60G1W	1.6	-50.2	3.4	45.0	-5.3	20.4	-29.8	24.8	33.1	24.5	27.7
100KG1W	0.1	-53.4	3.4	45.0	-8.4	20.4	-33.0	21.6	30.0	21.4	24.5

Table A2.12: Adjacent satellite into SES-3 uplink C/I – C-band

UPLINK C/I Analysis - Adjacent into SES

C-band	6175 MHz
SES orbital position	-103.0
Adj. orbital position	-101.0
Topocentric sep.	2.2 deg

SES carriers

Emission	36M0G7W	6M95G1W	1M60G1W	100KG1W
Bandwidth, MHz	36	6.95	1.6	0.1
Input power, dBW/Hz	-50.5	-58.9	-50.2	-53.4
Antenna size, m	4.5	3.7	3.4	3.4
Antenna gain, dBi	47.4	45.7	45.0	45.0
EIRP density, dBW/Hz	-3.1	-13.1	-5.3	-8.4
Sidelobe gain, dBi	20.4	20.4	20.4	20.4
Off-ax. EIRP dens, dBW/Hz	-30.1	-38.4	-29.8	-33.0

Adjacent satellite carriers

Emission	Bandwidth, MHz	Input power, dBW/Hz	Antenna size, m	Antenna gain, dBi	EIRP density, dBW/Hz	Sidelobe gain, dBi	Off-ax. EIRP dens, dBW/Hz	**C/I**	**C/I**	**C/I**	**C/I**
36M0G7W	36	-50.5	4.5	47.4	-3.1	20.4	-30.1	27.0	16.9	24.8	21.6
6M95G1W	6.95	-58.9	3.7	45.7	-13.1	20.4	-38.4	35.3	25.3	33.1	30.0
1M60G1W	1.6	-50.2	3.4	45.0	-5.3	20.4	-29.8	26.7	16.7	24.5	21.4
100KG1W	0.1	-53.4	3.4	45.0	-8.4	20.4	-33.0	29.9	19.8	27.7	24.5

Table A2.13: SES-3 into adjacent satellite downlink C/I – C-band

DOWNLINK C/I Analysis - SES into Adjacent

C-band	3950 MHz
SES orbital position	-103.0
Adj. orbital position	-101.0
Topocentric sep.	2.2 deg

SES carriers

Emission	36M0G7W	6M95G1W	1M60G1W	100KG1W
Bandwidth, MHz	36	6.95	1.6	0.1
Carrier EIRP density, dBW/Hz	-36.6	-36.6	-36.6	-36.6
Carrier EIRP, dBW	39.0	31.9	25.5	13.4
Rx ES antenna size, m	6.1	7.0	5.4	4.5
Rx ES antenna gain, dBi	46.2	47.4	45.1	43.5
Sidelobe gain, dBi	20.4	20.4	20.4	20.4

Adjacent satellite carriers

Emission	Bandwidth, MHz	Carrier EIRP density, dBW/Hz	Carrier EIRP, dBW	Rx ES antenna size, m	Rx ES antenna gain, dBi	Sidelobe gain, dBi	**C/I**	**C/I**	**C/I**	**C/I**
36M0G7W	36	-36.6	39.0	6.1	46.2	20.4	25.7	25.7	25.7	25.7
6M95G1W	6.95	-36.6	31.9	7.0	47.4	20.4	26.9	26.9	26.9	26.9
1M60G1W	1.6	-36.6	25.5	5.4	45.1	20.4	24.7	24.7	24.7	24.7
100KG1W	0.1	-36.6	13.4	4.5	43.5	20.4	23.1	23.1	23.1	23.1

Table A2.14: Adjacent satellite into SES-3 downlink C/I – C-band

DOWNLINK C/I Analysis - Adjacent into SES

C-band	3950 MHz
SES orbital position	-103.0
Adj. orbital position	-101.0
Topocentric sep.	2.2 deg

SES carriers

Emission	36M0G7W	6M95G1W	1M60G1W	100KG1W
Bandwidth, MHz	36	6.95	1.6	0.1
Carrier EIRP density, dBW/Hz	-36.6	-36.6	-36.6	-36.6
Carrier EIRP, dBW	39.0	31.9	25.5	13.4
Rx ES antenna size, m	6.1	7.0	5.4	4.5
Rx ES antenna gain, dBi	46.2	47.4	45.1	43.5
Sidelobe gain, dBi	20.4	20.4	20.4	20.4

Adjacent satellite carriers

Emission	Bandwidth, MHz	Carrier EIRP density, dBW/Hz	Carrier EIRP, dBW	Rx ES antenna size, m	Rx ES antenna gain, dBi	Sidelobe gain, dBi	**C/I**	**C/I**	**C/I**	**C/I**
36M0G7W	36	-36.6	39.0	6.1	46.2	20.4	25.7	26.9	24.7	23.1
6M95G1W	6.95	-36.6	31.9	7.0	47.4	20.4	25.7	26.9	24.7	23.1
1M60G1W	1.6	-36.6	25.5	5.4	45.1	20.4	25.7	26.9	24.7	23.1
100KG1W	0.1	-36.6	13.4	4.5	43.5	20.4	25.7	26.9	24.7	23.1

2 17/24 GHz Interference Analysis

As noted above, the 17/24 GHz BSS payload on SES-3 is licensed by Canada. SES is not applying for U.S. market access for that payload at this time, and therefore is not required to submit information related specifically to that payload. Nevertheless, SES hereby provides the following information about the 17/24 GHz BSS payload, in addition to the information provided elsewhere in this Technical Appendix.

2.1 Compliance with FCC's Four degree spacing rules

Pursuant to Sections 25.140(b)(3) and (5), SES hereby demonstrates that the 17/24 GHz payload on SES-3 can operate compatibly with a hypothetical 17/24 GHz BSS satellite operating at least 4 degrees away at 107° W.L. and with DIRECTV's RB-1 satellite, licensed to operate at 99.235° W.L. Specifically, SES-3 meets the pfd limits and off-axis EIRP density limits found in § 25.208(w) (as shown previously in Section 5 of this Technical Appendix) and § 25.223 (as shown below), which together establish the basis of the FCC's four-degree spacing rules for 17/24 GHz BSS.

2.1.1 Interference Analysis pursuant to § 25.140(b)(3) and (5) and of the Commission's rules

Table A2.15 shows C/I and C/(N+I) estimates of the SES-3 carriers when interfered with by a hypothetical adjacent satellite system four degrees away at 107° W.L. that is operating at the maximum satellite eirp density allowed by the FCC. A hypothetical satellite is used for this § 25.140(b)(3) analysis because there are no 17/24 GHz BSS space stations authorized by the FCC at 107° W.L., nor are there any pending applications.

Table A2.16 shows C/I and C/(N+I) estimates of the SES-3 carriers when interfered with by DTV RB-1 at 99.235° W.L., 3.765 degrees away. The interference from SES-3 into DTV RB-1 is also shown.

Consistent with § 25.140(b)(5), SES-3 does not cause more interference into DTV RB-1 with its slight offset than would be allowed at the nominal 4 degree 17/24 GHz satellite spacing. This is demonstrated by comparing the SES-3 pfd levels to the pfd limits of the FCC rules and taking into account the relative earth station antenna off-axis receive gain at 3.765 degrees and 4 degrees. In the worst case (see Section 5), SES-3's pfd level is 8.6 dB below the Commission's pfd limit. The antenna receive gain is 0.7 dB higher at 3.765 degrees than at 4 degrees. Thus, even at the closer spacing, the SES-3 pfd level is 7.9 dB below the applicable Commission limit.

2.2 Space-path Interference Analysis pursuant to § 25.264 of the Commission's rules

Section 25.264 of the Commission's rules was adopted to mitigate potential space path interference in the 17.3–17.8 GHz band. Subsections (a) and (b) describe the predicted data on 17/24 GHz off-axis gain and power flux density levels that must be filed in support of a 17/24 GHz BSS license application, and subsections (c) and (d) address submission of conforming measured data regarding these parameters.

Predicted data responding to subsections (a) and (b) of § 25.264 is provided in Tables A2.17 and A2.18 below. As can be seen in Table A2.18, the pfd values are below the -117 $dBW/m^2/100$ kHz threshold in the Commission's rules at all off-axis values starting at ±5° from 103° W.L.

Because the FCC had not yet released the space path interference rules when SES-3 was being constructed, only partial measurements were made on the 17/24 GHz antenna. Specifically, the measurements collected data with respect to only one polarization (RHCP), and only captured the antenna gain between ±80° around the boresight of the antenna. As a result, in Tables A2.19 and A2.20 below, the columns relating to LHCP and the rows relating to off-axis angles beyond ±80° from boresight are blank.

The predicted data in Tables A2.17 and A2.18 matches well with the measured data that was collected. On average, the measured data was approximately 1 dB lower than the predicted data, which in turn corresponds to approximately 1 dB lower pfd towards the adjacent orbital locations.

The analysis in Table A2.21 supplements the data described above by providing calculations for the minimum separation distance from SES-3 that would be required to protect DBS satellites. The table shows that SES-3 complies with the Commission's pfd threshold of -117 $dBW/m^2/MHz$ for any orbital location more than 0.01 geocentric degrees away, assuming the DBS satellite is at approximately 90° off-axis from boresight of the SES-3 17/24 GHz downlink antenna. As the nominal orbital separation between SES-3 and the edge of the nearest DBS cluster is 1.8 degrees, the SES-3 pfd received at the DBS antenna will be well below this threshold.

In addition, the 17/24 GHz payload will be operated at 103.0° W.L. with a maximum orbital eccentricity of less than 4.7×10^{-4}.

Table A2.15: Single-entry interference analysis for hypothetical adjacent 17/24 GHz satellite

	1M20G1W	5M50G1W
Bandwidth (MHz)	1.2	5.5
Uplink		
Uplink EIRP (dBW)	69.6	76.1
Uplink EIRP density (dBW/MHz)	68.8	68.7
§25.223 off-axis EIRP density (dBW/MHz)	17.4	17.4
Uplink C/I (dB)	51.3	51.2
Downlink		
SES Satellite EIRP (dBW)	33	33
SES Satellite EIRP density (dBW/MHz)	32.2	25.6
Interfering satellite PFD (dBW/m^2/MHz)	-115	-115
Interfering satellite EIRP density (dBW/MHz)	48.5	48.5
RX earth station antenna diameter (m)	0.95	1.5
RX earth station antenna gain (dBi)	43.0	46.9
Geocentric angle of neighboring satellite (°)	4	4
Topocentric angle (10% greater than geo. Angle)	4.40	4.40
Max satellite station keeping error (°)	0.05	0.05
RX earth station pointing error (°)	0.5	0.5
Net off-axis angle (°)	3.85	3.85
RX E/S off-axis gain: 29-25LOG(θ) (dB)	14.4	14.4
C/I downlink (dB)	12.3	9.7
C/N clear weather (dB)	15.1	12.4
C/(N+I), clear weather (dB)	10.5	7.8
Up and downlink		
C/N Required (dB)	4.7	1.3
C/(N+I), clear weather (dB)	10.5	7.8
C/(N+I) margin (dB)	5.8	6.5
Adjacent Satellite Received Interference from SES-3		
Uplink C/I (dB)	51.3	51.2
Satellite PFD (dBW/m^2/MHz)	-121	-121
Satellite EIRP density (dBW/MHz)	42.5	42.5
RX earth station antenna diameter (m)	0.45	0.45
RX earth station antenna gain (dBi)	36.5	36.5
RX E/S off-axis gain: 29-25LOG(θ) (dB)	14.4	14.4
C/I downlink (dB)	32.4	39.0
C/I System (dB)	32.4	38.8

Table A2.16: Single-entry interference analysis for the DTV RB1 17/24 GHz satellite at 99.235° W.L.

	1M20G1W	5M50G1W
Bandwidth (MHz)	1.2	5.5
Uplink		
Uplink EIRP (dBW)	69.6	76.1
Uplink EIRP density (dBW/MHz)	68.8	68.7
§25.223 off-axis EIRP density (dBW/MHz)	18.1	18.1
Uplink C/I (dB)	50.7	50.6
Downlink		
SES Satellite EIRP (dBW)	33	33
SES Satellite EIRP density (dBW/MHz)	32.2	25.6
Interfering satellite PFD (dBW/m^2/MHz)	-115	-115
Interfering satellite EIRP density (dBW/MHz)	48.5	48.5
RX earth station antenna diameter (m)	0.95	1.5
RX earth station antenna gain (dBi)	43.0	46.9
Geocentric angle of neighboring satellite (°)	3.765	3.765
Topocentric angle (10% greater than geo. Angle)	4.14	4.14
Max satellite station keeping error (°)	0.05	0.05
RX earth station pointing error (°)	0.5	0.5
Net off-axis angle (°)	3.59	3.59
RX E/S off-axis gain: 29-25LOG(θ) (dB)	15.1	15.1
C/I downlink (dB)	11.6	8.9
C/N clear weather (dB)	15.1	12.4
C/(N+I), clear weather (dB)	10.0	7.3
Up and downlink		
C/N Required (dB)	4.7	1.3
C/(N+I), clear weather (dB)	10.0	7.3
C/(N+I) margin (dB)	5.3	6.0
Adjacent Satellite Received Interference from SES-3		
Uplink C/I (dB)	50.7	50.6
Satellite PFD (dBW/m^2/MHz)	-121	-121
Satellite EIRP density (dBW/MHz)	42.5	42.5
RX earth station antenna diameter (m)	0.45	0.45
RX earth station antenna gain (dBi)	36.5	36.5
RX E/S off-axis gain: 29-25LOG(θ) (dB)	15.1	15.1
C/I downlink (dB)	31.7	38.3
C/I System (dB)	31.6	38.0

Table A2.17: Predicted 17 GHz transmitting antenna off-axis gain information

			Off-axis Gain for TX antenna	Off-axis Gain for TX antenna	Off-axis Gain for TX antenna	Off-axis Gain for TX antenna	Off-axis Gain for TX antenna	Off-axis Gain for TX antenna
		Polarization	RHCP	LHCP	RHCP	LHCP	RHCP	LHCP
		Frequency	17.305	17.305	17.550	17.550	17.795	17.795
Orbital Separation	Longitude	Off-Axis Angle						
60	-163	60.0	-23.6	-25.8	-24.3	-25.8	-21.2	-21.2
55	-158	62.5	-25.0	-26.5	-24.8	-25.7	-23.0	-23.4
50	-153	65.0	-24.8	-26.4	-25.4	-26.7	-24.5	-27.6
45	-148	67.5	-25.3	-26.3	-26.7	-28.5	-24.2	-26.3
40	-143	70.0	-26.0	-27.3	-28.3	-31.0	-24.5	-25.1
35	-138	72.5	-27.8	-28.9	-28.8	-30.1	-26.0	-26.8
30	-133	75.0	-29.1	-31.3	-29.9	-31.5	-27.2	-29.0
25	-128	77.5	-29.9	-32.4	-31.1	-32.4	-28.6	-28.1
20	-123	80.0	-31.8	-33.4	-32.6	-34.3	-27.1	-26.8
15	-118	82.5	-33.5	-35.1	-33.0	-33.8	-27.4	-27.7
10	-113	85.0	-34.4	-36.5	-32.2	-32.5	-27.7	-27.7
5	-108	87.5	-33.6	-35.7	-32.0	-32.0	-27.3	-27.3
SES-3	-103	90	-33.8	-35.9	-32.1	-32.3	-27.9	-28.3
5	-98	87.5	-33.6	-35.7	-32.0	-32.0	-27.3	-27.3
10	-93	85.0	-34.4	-36.5	-32.2	-32.5	-27.7	-27.7
15	-88	82.5	-33.5	-35.1	-33.0	-33.8	-27.4	-27.7
20	-83	80.0	-31.8	-33.4	-32.6	-34.3	-27.1	-26.8
25	-78	77.5	-29.9	-32.4	-31.1	-32.4	-28.6	-28.1
30	-73	75.0	-29.1	-31.3	-29.9	-31.5	-27.2	-29.0
35	-68	72.5	-27.8	-28.9	-28.8	-30.1	-26.0	-26.8
40	-63	70.0	-26.0	-27.3	-28.3	-31.0	-24.5	-25.1
45	-58	67.5	-25.3	-26.3	-26.7	-28.5	-24.2	-26.3
50	-53	65.0	-24.8	-26.4	-25.4	-26.7	-24.5	-27.6
55	-48	62.5	-25.0	-26.5	-24.8	-25.7	-23.0	-23.4
60	-43	60.0	-23.6	-25.8	-24.3	-25.8	-21.2	-21.2

Table A2.18: Predicted 17 GHz transmitting antenna off-axis pfd

		Polarization	RHCP	LHCP	RHCP	LHCP	RHCP	LHCP
		Frequency	17.305	17.305	17.550	17.550	17.795	17.795
Orbital Separation	Longitude	spreading loss			**pfd**			
60	-163	-163.5	-189.0	-191.2	-189.7	-191.2	-186.6	-186.6
55	-158	-162.8	-189.7	-191.2	-189.5	-190.4	-187.7	-188.1
50	-153	-162.0	-188.7	-190.4	-189.3	-190.6	-188.5	-191.5
45	-148	-161.2	-188.4	-189.4	-189.8	-191.6	-187.2	-189.4
40	-143	-160.2	-188.1	-189.4	-190.4	-193.1	-186.6	-187.2
35	-138	-159.1	-188.8	-189.9	-189.7	-191.1	-187.0	-187.8
30	-133	-157.8	-188.8	-190.9	-189.5	-191.2	-186.8	-188.7
25	-128	-156.2	-188.0	-190.6	-189.2	-190.5	-186.7	-186.3
20	-123	-154.3	-188.0	-189.6	-188.8	-190.5	-183.3	-183.0
15	-118	-151.8	-187.2	-188.8	-186.7	-187.5	-181.1	-181.5
10	-113	-148.3	-184.6	-186.7	-182.4	-182.7	-178.0	-177.9
5	-108	-142.3	-177.8	-179.9	-176.2	-176.2	-171.5	-171.5
SES-3	-103	0	-35.7	-37.8	-34.0	-34.2	-29.8	-30.2
5	-98	-142.3	-177.8	-179.9	-176.2	-176.2	-171.5	-171.5
10	-93	-148.3	-184.6	-186.7	-182.4	-182.7	-178.0	-177.9
15	-88	-151.8	-187.2	-188.8	-186.7	-187.5	-181.1	-181.5
20	-83	-154.3	-188.0	-189.6	-188.8	-190.5	-183.3	-183.0
25	-78	-156.2	-188.0	-190.6	-189.2	-190.5	-186.7	-186.3
30	-73	-157.8	-188.8	-190.9	-189.5	-191.2	-186.8	-188.7
35	-68	-159.1	-188.8	-189.9	-189.7	-191.1	-187.0	-187.8
40	-63	-160.2	-188.1	-189.4	-190.4	-193.1	-186.6	-187.2
45	-58	-161.2	-188.4	-189.4	-189.8	-191.6	-187.2	-189.4
50	-53	-162.0	-188.7	-190.4	-189.3	-190.6	-188.5	-191.5
55	-48	-162.8	-189.7	-191.2	-189.5	-190.4	-187.7	-188.1
60	-43	-163.5	-189.0	-191.2	-189.7	-191.2	-186.6	-186.6

Table A2.19: Measured antenna gain data from 17 GHz transmitting antenna

			Off-axis Gain for TX antenna	Off-axis Gain for TX antenna	Off-axis Gain for TX antenna	Off-axis Gain for TX antenna	Off-axis Gain for TX antenna	Off-axis Gain for TX antenna
		Polarization	RHCP	LHCP	RHCP	LHCP	RHCP	LHCP
		Frequency	17.305	17.305	17.550	17.550	17.795	17.795
Orbital Separation	Longitude	Off-Axis Angle						
60	-163	60.0	-23.4		-25.0		-23.6	
55	-158	62.5	-22.4		-24.0		-22.6	
50	-153	65.0	-23.4		-23.0		-26.6	
45	-148	67.5	-24.4		-26.0		-26.6	
40	-143	70.0	-27.4		-27.0		-26.6	
35	-138	72.5	-25.4		-27.0		-26.6	
30	-133	75.0	-27.4		-27.0		-26.6	
25	-128	77.5	-27.4		-27.0		-26.6	
20	-123	80.0	-27.4		-27.0		-26.6	
15	-118	82.5						
10	-113	85.0						
5	-108	87.5						
SES-3	-103	90						
5	-98	87.5						
10	-93	85.0						
15	-88	82.5						
20	-83	80.0	-27.4		-27.0		-26.6	
25	-78	77.5	-27.4		-27.0		-26.6	
30	-73	75.0	-27.4		-27.0		-26.6	
35	-68	72.5	-26.4		-27.0		-26.6	
40	-63	70.0	-25.4		-27.0		-26.6	
45	-58	67.5	-23.4		-24.0		-26.6	
50	-53	65.0	-23.4		-24.0		-23.6	
55	-48	62.5	-22.4		-23.0		-22.6	
60	-43	60.0	-24.4		-24.0		-23.6	

Table A2.20: Pfd from measured antenna gain from 17 GHz transmitting antenna

		Polarization	RHCP	LHCP	RHCP	LHCP	RHCP	LHCP
		Frequency	17.305	17.305	17.550	17.550	17.795	17.795
Orbital Separation	Longitude	spreading loss			**pfd**			
60	-163	-163.5	-188.8		-190.3		-189.0	
55	-158	-162.8	-187.1		-188.7		-187.3	
50	-153	-162.0	-187.3		-186.9		-190.6	
45	-148	-161.2	-187.5		-189.0		-189.7	
40	-143	-160.2	-189.5		-189.0		-188.7	
35	-138	-159.1	-186.4		-187.9		-187.6	
30	-133	-157.8	-187.1		-186.6		-186.3	
25	-128	-156.2	-185.5		-185.1		-184.8	
20	-123	-154.3	-183.6		-183.2		-182.8	
15	-118	-151.8						
10	-113	-148.3						
5	-108	-142.3						
SES-3	-103	0						
5	-98	-142.3						
10	-93	-148.3						
15	-88	-151.8						
20	-83	-154.3	-183.6		-183.2		-182.8	
25	-78	-156.2	-185.5		-185.1		-184.8	
30	-73	-157.8	-187.1		-186.6		-186.3	
35	-68	-159.1	-187.4		-187.9		-187.6	
40	-63	-160.2	-187.5		-189.0		-188.7	
45	-58	-161.2	-186.5		-187.0		-189.7	
50	-53	-162.0	-187.3		-187.9		-187.6	
55	-48	-162.8	-187.1		-187.7		-187.3	
60	-43	-163.5	-189.8		-189.3		-189.0	

Table A2.21: Required separation distance required to protect DBS satellites

FCC pfd limit into DBS satellites	dB(W/m2/100 kHz)	-117
SES downlink frequency	MHz	17800
SES downlink power density	dBW/Hz	-51.1
SES off-axis gain toward DBS satellite at 90° off-axis from boresight	dBi	-27
SES EIRP toward DBS satellite	dBW/Hz	-78.1
Spreading loss	dB	88.9
Orbital separation in km	km	7.9
Orbital separation in degrees	degrees	0.01

Engineering Declaration

DECLARATION OF Zachary Rosenbaum

I, Zachary Rosenbaum, hereby certify under penalty of perjury that I am the technically qualified person responsible for preparation of the technical information contained in the foregoing exhibit; that I am familiar with the technical requirements of Part 25; and that I either prepared or reviewed the technical information contained in the exhibit and that it is complete and accurate to the best of my knowledge, information and belief.

/s/

Engineer, Spectrum Management and Development
SES Americom, Inc.

Dated: 28 December 2012