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

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|---|---|---|
| In the Matter of Application by | ) | |
| | ) | |
| SES AMERICOM, INC. | ) | File No. SAT-MOD-_____ |
| | ) | Call Sign S2181 |
| For Modification of AMC-16 | ) | |
| Fixed-Satellite Space Station License | ) | |

## APPLICATION OF SES AMERICOM, INC.

SES Americom, Inc. (doing business as "SES"), hereby respectfully requests a modification of its license for the AMC-16 fixed-satellite space station to permit reorientation of the satellite's Ka-band beams. Grant of the requested authority will enable SES to tailor the Ka-band coverage of AMC-16 to better accommodate customer service requirements.

A completed FCC Form 312 is attached, and SES incorporates by reference the technical information previously provided in support of AMC-16.[1] In addition, SES is providing information relating to the proposed modification to the AMC-16 license in the attached Technical Appendix and Schedule S.

## MODIFICATION

AMC-16 is a Ku/Ka-band hybrid spacecraft launched in 2004 and operating at 85° W.L. SES has a customer request for repointing to slightly adjust the satellite's Ka-band coverage. No change in the Ku-band gain contours of the satellite is planned. SES proposes to

[1] *See* File Nos. SAT-MOD-20060929-00113; SAT-MOD-20050621-00132; SAT-AMD-20051115-00218; SAT-RPL-20040227-00024; SAT-MOD-20040227-00022 & SAT-LOA-19950929-00133.

accomplish the desired effect by reorienting AMC-16 to obtain the desired Ka-band coverage and using the gimbal on the Ku-band antenna to maintain the current Ku-band coverage pattern.

Reorientation of AMC-16 as proposed will not adversely affect any other operators. The technical appendix includes an interference analysis demonstrating that operation of the AMC-16 Ka-band antenna with the proposed modified coverage will conform to Commission requirements for operations at two-degree spacing. AMC-16 will also be operated consistent with applicable existing and future coordination agreements.[2]

Furthermore, the proposed change will not impair service to existing customers. Because there will be no change to the AMC-16 Ku-band coverage area, customers receiving Ku-band service from AMC-16 will be unaffected.

The Commission has generally permitted satellite operators the flexibility to design and modify their networks in response to customer requirements, absent compelling countervailing public interest considerations.[3] Here, grant of the requested modification will permit SES to accommodate customer requirements and facilitate efficient use of AMC-16 to provide service to customers.

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[2] SES has previously coordinated the Ka-band operations of AMC-16 with U.S. Federal systems, as required by footnote US 334 to the table of frequency allocations, 47 C.F.R. § 2.106. SES will advise the appropriate U.S. government representative regarding the proposed change in coverage of the AMC-16 Ka-band payload.

[3] *See, e.g. AMSC Subsidiary Corporation*, 13 FCC Rcd 12316 at ¶ 8 (IB 1998) (the Commission generally leaves space station design decisions to the licensee "because the licensee is in a better position to determine how to tailor its system to meet the particular needs of its customers") (footnote omitted).

## WAIVER REQUEST

SES seeks any necessary waiver of Sections 25.114(d)(14)(ii) and 25.283(c) of the Commission's rules in connection with the requested AMC-16 modification.[4] Grant of the 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.[5]

Sections 25.114(d)(14)(ii) and 25.283(c) address requirements relating to venting stored energy sources at the spacecraft's end of life.[6] AMC-16 is a Lockheed Martin A2100 model spacecraft. As described in more detail in the attached Technical Appendix, the oxidizer tanks on the spacecraft were sealed following completion of the launch phase and will therefore retain residual pressure when the spacecraft is retired. Given the spacecraft design, it is physically impossible for SES to vent the oxidizer tanks in order to comply with Section 25.283(c).

Under Commission precedent, grant of a waiver is warranted. In a number of cases involving various spacecraft models with similar limitations, the Commission has waived

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[4] As discussed in the Technical Appendix, operation of AMC-16 as modified will conform to the terms of the waiver previously granted by the Commission with respect to the cross-polarization isolation requirements of Section 25.210(i) of the Commission's rules. *See* Technical Appendix at 2 & n.3.

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

[6] Section 25.283(c) contains the substantive venting requirement, and Section 25.114(d)(14)(ii) requires applicants to submit information that addresses "whether stored energy will be removed at the spacecraft's end of life." 47 C.F.R. § 25.114(d)(14)(ii).

Section 25.283(c) to permit launch and operation of spacecraft that do not allow for full venting of pressure vessels at end of life, based on a finding that modifying the space station design at a late stage of construction would pose an undue hardship.[7] SES would have faced the same hardship if it had been required to alter the design of AMC-16 to conform to Section 25.283(c) prior to launch of the spacecraft.

With AMC-16 already in orbit and operational, there is no question of bringing the satellite into compliance with the rule. The Commission has expressly recognized this, finding a waiver of Section 25.283(c) to be justified for in-orbit spacecraft that cannot satisfy the rule's requirements. For example, in a decision involving the SES AMC-2 satellite, the Commission waived the rule on its own motion, observing that venting the spacecraft's sealed oxidizer tanks "would require direct retrieval of the satellite, which is not currently possible."[8]

The same practical obstacle is present here. Because AMC-16 is already in orbit, SES can do nothing to enable full venting of residual pressure in the oxidizer tanks. Given this reality, a waiver is clearly warranted.

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[7] *See, e.g., EchoStar Satellite Operating Corp.*, Call Sign S2746, File No. SAT-LOA-20071221-00183, grant-stamped Mar. 12, 2008, Attachment at ¶ 4 (granting a partial waiver of Section 25.283(c) for AMC-14, a Lockheed Martin A2100 model spacecraft, on the grounds that requiring modification of the satellite would present an undue hardship); *DIRECTV Enterprises LLC*, Call Sign S2797, File No. SAT-LOA-20090807-00086, grant-stamped Dec. 15, 2009, Attachment at ¶ 4 (same for DIRECTV 12, a Boeing 702 model spacecraft); *PanAmSat Licensee Corp.*, Call Sign S2237, File Nos. SAT-MOD-20070207-00027, SAT-AMD-20070716-00102, grant-stamped Oct. 4, 2007, Attachment at ¶ 7 (same for Intelsat 11, an Orbital Sciences Star model spacecraft).

[8] *SES Americom, Inc.*, Call Sign S2134, File No. SAT-MOD-20101215-00261, grant-stamped Mar. 8, 2011, Attachment at ¶ 4. *See also XM Radio Inc.*, Call Sign S2616, File No. SAT-MOD-20100722-00165, grant-stamped Oct. 14, 2010, Attachment at ¶ 2 (waiving Section 25.283(c) for XM-4, a Boeing 702 model spacecraft, because "modification of the spacecraft would present an undue hardship, since XM-4 is an in-orbit space station and venting XM-4's helium and xenon tanks would require direct retrieval of the satellite, which is not currently possible").

## CONCLUSION

For the foregoing reasons, SES respectfully requests expeditious grant of a modification of the AMC-16 license to permit reorientation of the spacecraft in order to adjust the Ka-band footprint as described herein.

Respectfully submitted,

SES AMERICOM, INC.

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# TECHNICAL APPENDIX

## 1.0 Overall Description

This technical appendix is being filed in support of the application of SES Americom for modification of the license for the AMC-16 Ku-band/Ka-band spacecraft to change the pointing of the Ka-band beams. The Ku-band beam pointing remains unchanged; as a result, the accompanying Schedule S only provides information on the Ka band payload. This modification also provides some minor updates to the spacecraft operating conditions. As modified, the spacecraft's Ka-band payload (downlinks in the frequency ranges of 18.6-18.8 GHz and 19.7-20.2 GHz and uplinks in the frequency ranges of 28.4-28.6 GHz and 29.5-30 GHz) will continue to operate with 10 spot beams[1] providing coverage of the Continental United States, but with a slightly different coverage for each beam.

The interference analysis provided in Appendix 2 of this filing demonstrates that AMC-16 complies with Commission standards for Ka-band operations in a two-degree spacing environment with the modified pointing. Specifically, the analysis shows that the limits in Section 25.138 will be met and therefore this modification will not adversely affect adjacent satellite operations.

In addition, this modification application updates the polarizations associated with AMC-16's TT&C sub-system and also updates some of the spacecraft's physical and electrical characteristics.

[1] The Ka-band payload of AMC-16 has 12 spot beams. However, only 10 spot beams are used in the configuration described in this modification application. Two of the 12 spot beams are turned off because they do not cover geographic areas where service can be provided.

Table 1 below provides a cross-reference to technical information supplied in the 2004 application[2] for the AMC-16 Ka-band payload and identifies whether any changes are proposed in the instant modification, with citations to the location of the modified information.

***Table 1: Ka-band Technical Information***

| | Section number in the 2004 Ka-band Filing | Location herein of any revised information |
|---|---|---|
| **Overall Description** | 1.0 | 1.0 |
| **Communications Payload** | 2.0 | 2.0 |
| • Transponder Characteristics | 2.1 | 2.1 |
| - Ku-band configuration | 2.1.1 | No changes |
| - Ka-band configuration | 2.1.2 | 2.1 |
| • Emission Designators | 2.2 | 2.2 |
| • Communications Coverage | 2.3 | |
| - Ku-Band Transponders | 2.3.1 | No changes |
| - Ka-band Transponders | 2.3.2 | 2.3; App. 1 |
| • Noise Temperatures | 2.4 | No changes |
| • Gain | 2.5 | No changes |
| • Flux Control/IF Processor Attenuators | 2.6 | No changes |
| • Saturation Flux Density | 2.7 | No changes |
| • Transponder Gain | 2.8 | No changes |
| • Spurious Emissions | 2.9 | No changes |
| • Cross Polarization Isolation[3] | 2.10 | No changes |
| • Frequency Tolerance | 2.11 | No changes |
| • Link Budgets | 2.12 | 2.4 |
| • Cessation of Emissions | 2.13 | No changes |
| • Interference Analysis | 2.14 | No changes for Ku; Appendix 2 |

[2] File No. SAT-MOD-20040227-00022 (the "2004 Ka-band Filing").

[3] The grant of the 2004 Ka-band Filing included a waiver of the cross-polarization isolation requirements contained in Section 25.210(i) for the Ka-band payload. *See* File No. SAT-MOD-20040227-00022, grant-stamped Sept. 2, 2004, Terms and Conditions at ¶ 4 (authorizing AMC-16 with a Ka-band cross-polarization isolation ratio of 23 dB throughout the spacecraft's service area rather than the 30 dB required under the rule based on a demonstration that the shortfall will not adversely impact any other operator). The operation of the Ka-band payload under the modification proposed herein will continue to comply with the terms of this waiver.

| | | |
|---|---|---|
| **Spacecraft Bus Description** | 3.0 | No changes |
| • Tracking, Telemetry, and Command (TT&C) Subsystem[4] | 3.1 | 3.1 |
| • Attitude Control and Station-keeping subsystem | 3.2 | No changes |
| • Electrical Power Subsystem | 3.3 | 3.2 |
| • Propulsion | 3.4 | No changes |
| • Structural Compatibility, Dimensions and Mass Budget | 3.5 | 3.3 |
| • Thermal Control Subsystem | 3.6 | No changes |
| • Reliability and operational life | 3.7 | No changes |
| **Orbital Arc Considerations** | 4.0 | No changes |
| **Appendix 1 Coverage Maps for Ku-Band Contours** | | No changes |
| **Appendix 2 Coverage Maps for Ka-Band Contours** | | Appendix 1 |
| **Section 25.138 Analysis (Ka-band Two Degree Spacing)** | | Appendix 2 |

## 2.0 Communications Payload: Ka-band configuration

### 2.1 Frequency Plan

In the Ka-band frequencies, AMC-16 will utilize 10 transponders of 125 MHz each, using spatial separation to provide two times frequency re-use. Each beam has two modes that are selectable by ground command: a centered wideband channel of 125 MHz or three subchannels of 39 MHz each. Each uplink beam can be routed to any or all downlink beams individually. Any 39 MHz subchannel can be switched to any of the three downlink subchannels by ground command. Each transponder will have a maximum EIRP of between 60.7 and 62 dBW/125 MHz. The frequency plan for the Ka-band transponders will continue to be that shown in Table 2. The frequency plan for the 10 operational beams is shown in Table 3.

[4] The Ka-band beacon (18584 MHz, LHCP) is not presently used for TT&C purposes, although it is switched on in order for the Ka-band traffic to have a reference and to locate the spacecraft. This will not change with the repointing.

*Table 2: Ka-Band Frequency Plan*

| Channel number | Uplink Center Frequency (GHz) | Downlink Center Frequency (GHz) |
|---|---|---|
| 1 | 28.5005 | 18.7005 |
| 2 | 29.5625 | 19.7625 |
| 3 | 29.6875 | 19.8875 |
| 4 | 29.8125 | 20.0125 |
| 5 | 29.9375 | 20.1375 |

*Table 3: Uplink and downlink frequencies of beams and subchannels*

Note: The center frequencies of wideband (125 MHz) channels are the same as those of subchannel "b" of that beam.

| Beams | Subchannel | Uplink frequency (GHz) | Downlink frequency (GHz) |
|---|---|---|---|
| 1A, 1B | a | 28.4575 | 18.6575 |
| | b | 28.5005 | 18.7005 |
| | c | 28.5435 | 18.7435 |
| 2A, 2B | a | 29.5195 | 19.7195 |
| | b | 29.5625 | 19.7625 |
| | c | 29.6055 | 19.8055 |
| 3A, 3B | a | 29.6445 | 19.8445 |
| | b | 29.6875 | 19.8875 |
| | c | 29.7305 | 19.9305 |
| 4A, 4B | a | 29.7695 | 19.9695 |
| | b | 29.8125 | 20.0125 |
| | c | 29.8555 | 20.0555 |
| 5A, 5B | a | 29.8945 | 20.0945 |
| | b | 29.9375 | 20.1375 |
| | c | 29.9805 | 20.1805 |

## 2.2 Emission Designators

The emission designators for communications, command, and downlink beacon signals as well as typical communications carriers to be used on AMC-16 are shown in Table 4.

***Table 4: Emission Designators***

| Signal | Emission Designator |
|---|---|
| Command | 800KF9D |
| Telemetry/Ranging | 300KF9D |
| Digital Compressed Television | 36M0G7W |
| Digital Compressed Television | 27M0G7W |
| Digital SCPC – FDMA 56 kbps, QPSK Modulated | 100KG1W |
| T1 (1.544 Mbps),QPSK Modulated | 1M60G7W |
| High Speed Digital Data (various data rates & modulation/coding rates) | 42M0G7W |
| High Speed Digital Data (60 Mbps) 8PSK Modulated | 39M1G7W |
| Digital TV (8 Mbps) QPSK Modulated | 7M00G7W |
| High Speed Digital Data (100 Mbps) QPSK Modulated | 98M0G7W |
| High Speed Digital Data (73 Mbps) 8PSK Modulated | 48M0G7W |
| High Speed Digital Data (110 Mbps) 16QAM Modulated | 42M0G7W |
| VSAT return link (1.2 Mbps) QPSK Modulated | 1M50G7W |
| VSAT return link (various data rates and modulation/coding rates) | 2M40G7W, 305KG1W, 36K0G1W |

## 2.3 Ka-band Transponders

Attached hereto as Appendix 1 are coverage maps of each individual beam for the proposed nominal pointing. The maximum EIRP of any Ka-band beam ranges from 60.7 to 62.0 dBW/125 MHz.

## 2.4 Ka-band Link Budgets

This section reproduces the Ka-band link budgets contained in the 2004 Ka-band Filing, with some minor editorial changes.

The services provided by AMC-16 will be wide ranging, including digital TV and digital transmission services ranging from 56 kbps to high-speed. Table 5 provides the characteristics of the earth stations used for this analysis at Ka-band. Tables 6-19 contain the link budget data described above using the earth station characteristics of Table 5.

***Table 5: Ka-Band Earth Station Sizes Used in Link Budget Analysis (Table 24 in 2004 application)***

| Carrier Type | Earth Station Diameter Uplink (meters) | Earth Station Diameter Downlink (meters) |
|---|---|---|
| 8-PSK 60 MBPS Data | 6.0 | 1.2 |
| Digital TV 8 MBPS QPSK | 4.5 | 1.2 |
| QPSK 100 MBPS Data | 6.0 | 0.65 |
| 8PSK 73 MBPS Data | 6.0 | 0.65 |
| QPSK 1.2 MBPS Data | 0.65 | 6.0 |
| QPSK 3/4 DVB S2 52 Mbps | 8.0 | 0.65 |
| 8PSK 2/3 DVB S2 70 Mbps | 8.0 | 0.65 |
| 16APSK 3/4 DVB S2 100 Mbps | 8.0 | 0.65 |
| QPSK 3/4 DVB S2 3 Mbps | 0.65 | 8.0 |
| 8PSK 2/3 DVB S2 4 Mbps | 0.65 | 8.0 |
| QPSK 3/4 DVB S2 380 kbps | 0.65 | 8.0 |
| BPSK 2/3 DVB S2 20 kbps | 0.65 | 8.0 |

***Table 6: Uplink Link Budget Calculations Digital***
***(Table 25 in 2004 application)***

| Parameter | 8PSK 2-3 DVB S2 60 Mbps | QPSK 3-4 RS 8 Mbps |
|---|---|---|
| Transmit Power(dBW) | 11.34 | 9.41 |
| Transmit Loss (dB) | -1.00 | -1.00 |
| Antenna Gain (dBi) | 63.49 | 60.99 |
| Ground Station EIRP (dBW) | 73.83 | 69.40 |
| Uplink Rain Loss (dB) | 0.00 | 0.00 |
| Free Space Loss (dB) | -213.33 | -213.33 |
| Satellite G/T (dB/K) | 9.00 | 9.00 |
| Data Rate (dB-Hz) | 77.77 | 69.03 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 | -228.60 |
| Eb/No (dB) | 20.33 | 24.64 |
| Eb/Io (dB) | 17.34 | 18.59 |
| Total Eb/(No + Io) (dB) For $10^{-7}$ | 15.57 | 17.63 |

***Table 7: Downlink Link Budget and Overall Calculation Digital***
***(Table 26 in 2004 application)***

| Parameter | 8PSK 2-3 DVB S2 60 Mbps | QPSK 3-4 RS 8 Mbps |
|---|---|---|
| Satellite Carrier EIRP (dBW) | 50.33 | 42.60 |
| Downlink Rain Loss (dB) | -9.00 | -9.00 |
| Free Space Loss (dB) | -209.93 | -209.93 |
| Ground Station G/T (dB/K) | 25.59 | 25.59 |
| Bit Rate (dB-Hz) | 77.77 | 69.03 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 | -228.60 |
| Eb/No (dB) | 7.82 | 8.83 |
| Eb/Io (dB) | 17.34 | 18.59 |
| Eb/(No + Io) (dB) | 7.36 | 8.39 |
| Total UP/DOWN Eb/(No+Io) (dB) | 6.75 | 7.90 |
| Required Total Eb/(No+Io) (dB) | 4.60 | 5.50 |
| Margin (dB) | 2.15 | 2.40 |

***Table 8: Uplink Link Budget Calculations Wide Band Digital***
***(Table 27 in 2004 application)***

| Parameter | QPSK 2-3 RS 100 Mbps | 8PSK 2-3 RS 73 Mbps |
|---|---|---|
| Transmit Power(dBW) | 18.31 | 14.56 |
| Transmit Loss (dB) | -1.00 | -1.00 |
| Antenna Gain (dBi) | 63.49 | 63.49 |
| Ground Station EIRP (dBW) | 80.80 | 77.05 |
| Uplink Rain Loss (dB) | 0.00 | 0.00 |
| Free Space Loss (dB) | -213.33 | -213.33 |
| Satellite G/T (dB/K) | 9.00 | 9.00 |
| Data Rate (dB-Hz) | 80.00 | 78.63 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 | -228.60 |
| Eb/No (dB) | 25.07 | 22.69 |
| Eb/Io (dB) | 18.11 | 16.34 |
| Total Eb/(No + Io) (dB) For $10^{-7}$ | 17.31 | 15.44 |

***Table 9: Downlink Link Budget and Overall Calculation Wide Band Digital***
***(Table 28 in 2004 application)***

| Parameter | QPSK 2-3 RS 100 Mbps | 8PSK 2-3 RS 73 Mbps* |
|---|---|---|
| Satellite Carrier EIRP (dBW) | 59.10 | 52.25 |
| Downlink Rain Loss (dB) | -9.00 | -1.00 |
| Free Space Loss (dB) | -209.93 | -209.93 |
| Ground Station G/T (dB/K) | 20.26 | 20.26 |
| Bit Rate (dB-Hz) | 80.00 | 78.63 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 | -228.60 |
| Eb/No (dB) | 9.03 | 11.55 |
| Eb/Io (dB) | 18.11 | 16.34 |
| Eb/(No + Io) (dB) | 8.53 | 10.31 |
| Total UP/DOWN Eb/(No+Io) (dB) | 7.99 | 9.14 |
| Required Total Eb/(No+Io) (dB) | 5.00 | 6.80 |
| Margin (dB) | 2.99 | 2.34 |

*For these links, the coding rate is controlled dynamically to compensate for rain fade.

***Table 10: Uplink Link Budget Calculations Narrow Band Digital (Table 29 in 2004 application)***

| Parameter | QPSK 1-2 (Turbo) 1.2 Mbps |
|---|---|
| Transmit Power(dBW) | -0.78 |
| Transmit Loss (dB) | -1.00 |
| Antenna Gain (dBi) | 44.18 |
| Ground Station EIRP (dBW) | 42.40 |
| Uplink Rain Loss (dB) | 0.00 |
| Free Space Loss (dB) | -213.33 |
| Satellite G/T (dB/K) | 9.00 |
| Data Rate (dB-Hz) | 60.79 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 |
| Eb/No (dB) | 5.88 |
| Eb/Io (dB) | 22.22 |
| Total Eb/(No + Io) (dB) For $10^{-7}$ | 5.78 |

***Table 11: Downlink Link Budget and Overall Calculation Narrow Band Digital (Table 30 in 2004 application)***

| Parameter | QPSK 1-2 (Turbo) 1.2 Mbps* |
|---|---|
| Satellite Carrier EIRP (dBW) | 17.60 |
| Downlink Rain Loss (dB) | -1.00 |
| Free Space Loss (dB) | -209.93 |
| Ground Station G/T (dB/K) | 39.57 |
| Bit Rate (dB-Hz) | 60.79 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 |
| Eb/No (dB) | 14.05 |
| Eb/Io (dB) | 22.22 |
| Eb/(No + Io) (dB) | 13.43 |
| Total UP/DOWN Eb/(No+Io) (dB) | 5.09 |
| Required Total Eb/(No+Io) (dB) | 2.70 |
| Margin (dB) | 2.39 |

*For these links, the coding rate is controlled dynamically to compensate for rain fade.

***Table 12: Uplink Link Budget Calculations Digital***
***(Table 31 in 2004 application)***

| Parameter | QPSK 3/4 DVB S2 52 Mbps | 8PSK 2/3 DVB S2 70 Mbps |
|---|---|---|
| Transmit Power(dBW) | 8.00 | 8.00 |
| Transmit Loss (dB) | -1.00 | -1.00 |
| Antenna Gain (dBi) | 65.99 | 65.99 |
| Ground Station EIRP (dBW) | 72.99 | 72.99 |
| Uplink Rain Loss (dB) | 0.00 | 0.00 |
| Free Space Loss (dB) | -213.33 | -213.33 |
| Satellite G/T (dB/K) | 9.00 | 9.00 |
| Data Rate (dB-Hz) | 77.17 | 78.42 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 | -228.60 |
| Eb/No (dB) | 20.09 | 18.84 |
| Eb/Io (dB) | 14.76 | 16.03 |
| Total Eb/(No + Io) (dB) For $10^{-7}$ | 13.64 | 14.20 |

***Table 13: Downlink Link Budget and Overall Calculation Digital***
***(Table 32 in 2004 application)***

| Parameter | QPSK 3/4 DVB S2 52 Mbps | 8PSK 2/3 DVB S2 70 Mbps |
|---|---|---|
| Satellite Carrier EIRP (dBW) | 53.00 | 53.00 |
| Downlink Rain Loss (dB) | -9.50 | -6.25 |
| Free Space Loss (dB) | -209.93 | -209.93 |
| Ground Station G/T (dB/K) | 20.26 | 20.26 |
| Bit Rate (dB-Hz) | 77.17 | 78.42 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 | -228.60 |
| Eb/No (dB) | 5.26 | 7.26 |
| Eb/Io (dB) | 14.76 | 16.03 |
| Eb/(No + Io) (dB) | 4.80 | 6.72 |
| Total UP/DOWN Eb/(No+Io) (dB) | 4.27 | 6.01 |
| Required Total Eb/(No+Io) (dB) | 3.06 | 4.58 |
| Margin (dB) | 1.21 | 1.43 |

***Table 14: Uplink Link Budget Calculations Digital***
***(Table 33 in 2004 application)***

| Parameter | 16APSK 3/4 DVB S2 100 Mbps | QPSK 3/4 DVB S2 3 Mbps |
|---|---|---|
| Transmit Power(dBW) | 8.00 | 3.00 |
| Transmit Loss (dB) | -1.00 | 0.00 |
| Antenna Gain (dBi) | 65.99 | 44.18 |
| Ground Station EIRP (dBW) | 72.99 | 47.18 |
| Uplink Rain Loss (dB) | 0.00 | 0.00 |
| Free Space Loss (dB) | -213.33 | -213.33 |
| Satellite G/T (dB/K) | 9.00 | 9.00 |
| Data Rate (dB-Hz) | 80.18 | 64.87 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 | -228.60 |
| Eb/No (dB) | 17.08 | 6.58 |
| Eb/Io (dB) | 17.77 | 17.76 |
| Total Eb/(No + Io) (dB) For $10^{-7}$ | 14.40 | 6.26 |

***Table 15: Downlink Link Budget and Overall Calculation Digital***
***(Table 34 in 2004 application)***

| Parameter | 16APSK 3/4 DVB S2 100 Mbps | QPSK 3/4 DVB S2 3 Mbps |
|---|---|---|
| Satellite Carrier EIRP (dBW) | 53.00 | 36.18 |
| Downlink Rain Loss (dB) | -3.00 | -12.00 |
| Free Space Loss (dB) | -209.93 | -209.93 |
| Ground Station G/T (dB/K) | 20.26 | 39.57 |
| Bit Rate (dB-Hz) | 80.18 | 64.87 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 | -228.60 |
| Eb/No (dB) | 8.75 | 17.55 |
| Eb/Io (dB) | 17.77 | 17.76 |
| Eb/(No + Io) (dB) | 8.24 | 14.64 |
| Total UP/DOWN Eb/(No+Io) (dB) | 7.30 | 5.67 |
| Required Total Eb/(No+Io) (dB) | 5.42 | 3.06 |
| Margin (dB) | 1.88 | 2.61 |

***Table 16: Uplink Link Budget Calculations Digital***
***(Table 35 in 2004 application)***

| Parameter | 8PSK 2/3 DVB S2 4 Mbps | QPSK 3/4 DVB S2 380 kbps |
|---|---|---|
| Transmit Power(dBW) | 3.00 | -3.00 |
| Transmit Loss (dB) | 0.00 | 0.00 |
| Antenna Gain (dBi) | 44.18 | 44.18 |
| Ground Station EIRP (dBW) | 47.18 | 41.18 |
| Uplink Rain Loss (dB) | 0.00 | 0.00 |
| Free Space Loss (dB) | -213.33 | -213.33 |
| Satellite G/T (dB/K) | 9.00 | 9.00 |
| Data Rate (dB-Hz) | 66.12 | 55.84 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 | -228.60 |
| Eb/No (dB) | 5.33 | 9.61 |
| Eb/Io (dB) | 19.03 | 17.76 |
| Total Eb/(No + Io) (dB) For $10^{-7}$ | 5.15 | 8.99 |

***Table 17: Downlink Link Budget and Overall Calculation Digital***
***(Table 36 in 2004 application)***

| Parameter | 8PSK 2/3 DVB S2 4 Mbps | QPSK 3/4 DVB S2 380 kbps |
|---|---|---|
| Satellite Carrier EIRP (dBW) | 36.18 | 30.18 |
| Downlink Rain Loss (dB) | -3.00 | -12.00 |
| Free Space Loss (dB) | -209.93 | -209.93 |
| Ground Station G/T (dB/K) | 39.57 | 39.57 |
| Bit Rate (dB-Hz) | 66.12 | 55.84 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 | -228.60 |
| Eb/No (dB) | 25.30 | 20.58 |
| Eb/Io (dB) | 19.03 | 17.76 |
| Eb/(No + Io) (dB) | 18.11 | 15.94 |
| Total UP/DOWN Eb/(No+Io) (dB) | 4.93 | 8.19 |
| Required Total Eb/(No+Io) (dB) | 4.58 | 3.06 |
| Margin (dB) | 0.35 | 5.13 |

***Table 18: Uplink Link Budget Calculations Digital***
***(Second Table 36 in 2004 application)***

| Parameter | BPSK 2/3 DVB S2 20 kbps |
|---|---|
| Transmit Power(dBW) | -12.00 |
| Transmit Loss (dB) | 0.00 |
| Antenna Gain (dBi) | 44.18 |
| Ground Station EIRP (dBW) | 32.18 |
| Uplink Rain Loss (dB) | 0.00 |
| Free Space Loss (dB) | -213.33 |
| Satellite G/T (dB/K) | 9.00 |
| Data Rate (dB-Hz) | 43.29 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 |
| Eb/No (dB) | 13.16 |
| Eb/Io (dB) | 14.26 |
| Total Eb/(No + Io) (dB) For $10^{-7}$ | 10.67 |

***Table 19: Downlink Link Budget and Overall Calculation Digital***
***(Table 37 in 2004 application)***

| Parameter | BPSK 2/3 DVB S2 20 kbps |
|---|---|
| Satellite Carrier EIRP (dBW) | 21.18 |
| Downlink Rain Loss (dB) | -20.00 |
| Free Space Loss (dB) | -209.93 |
| Ground Station G/T (dB/K) | 39.57 |
| Bit Rate (dB-Hz) | 43.29 |
| Boltzmann's Constant (dBW/K-Hz) | -228.60 |
| Eb/No (dB) | 16.13 |
| Eb/Io (dB) | 14.26 |
| Eb/(No + Io) (dB) | 12.09 |
| Total UP/DOWN Eb/(No+Io) (dB) | 8.31 |
| Required Total Eb/(No+Io) (dB) | 1.83 |
| Margin (dB) | 6.48 |

## 3.0 Spacecraft Bus Description

### 3.1 Tracking, Telemetry, and Command (TT&C) Subsystem

The telemetry and command subsystem will consist of redundant receivers and transmitters, which will be able to operate through an omnidirectional antenna for transfer orbit mode and emergency on-station mode, wide angle horns for transfer orbit and on-station modes (command and telemetry), and through the communications antennas for on-station mode (telemetry). The satellite uses three independent Ku-band uplink command receivers and three downlink telemetry beacons, two at Ku-band and one at Ka-band, located at the band edges as shown in Table 20.

***Table 20: AMC-16 Command and Telemetry Plan***

| Function | Frequency | Polarization |
|---|---|---|
| Ku Low Beacon | 11700.75 | H or RHCP |
| Ku High Beacon | 12199.25 | V or LHCP |
| Ka Beacon | 18584.0 | LHCP |
| Command | 14001.5 | V |

### 3.2 Electrical Power Subsystem

The power subsystem provides electrical power generation, storage, conditioning and distribution to ensure uninterrupted communications services over the life of the mission. The solar arrays will be attached to the satellite by a solar array drive mechanism that serves to rotate the solar array wings to follow the sun and transmit the solar electrical power through to the satellite equipment.

In order to provide uninterrupted communications services and support the other subsystems through Equinox eclipse periods, the electrical power is temporarily provided by batteries. The

Nickel Hydrogen batteries have sufficient capacity to provide for operation of the payload over the 15-year life of the spacecraft.

Table 21 provides an updated Power Budget for the 15-year life of the spacecraft.

***Table 21: AMC-16 EOL Power Budget***

| System | Summer Solstice | Equinox |
|---|---|---|
| Payload | 2235 | 2235 |
| Bus | 1665 | 2239 |
| Total Load | 3900 | 4474 |
| Solar Array | 3900 | 4500 |
| Battery DOD | 40 | |

### 3.3 Structural Compatibility, Dimensions and Mass Budget

The updated Mass Budget for a 15 year spacecraft life is as shown in Table 22.

***Table 22: AMC-16 Mass Budget Summary***

| System | Mass (Kg) |
|---|---|
| S/C Total Dry Mass | 1952 |
| Fuel/Pressurant/Oxidizer | 2133 |
| Total Lift Off Mass | 4065 |

## 4.0 Orbital Debris Mitigation

The information for AMC-16 required under Section 25.114(d)(14) of the Commission's rules is already on file with the Commission, and SES incorporates that information by reference herein.[5] SES hereby submits the following supplemental information regarding orbital debris mitigation:

[5] *See* File No. SAT-AMD-20051115-00218, Attachment 1.

**§ 25.114(d)(14)(ii):**

At the end of operational life, after the satellite has reached its final disposal orbit, onboard sources of stored energy will be depleted or secured, and the batteries will be discharged. However, at the end of AMC-16's operational life, there will be oxidizer remaining in the tanks that cannot be vented. Following insertion of the spacecraft into orbit, the spacecraft manufacturer permanently sealed the oxidizer tanks by firing pyrotechnic valves. Information regarding the residual oxidizer in the tanks is as follows:

| Tank | Volume [l] | pressure [bar] | temp. [deg C] | Oxidizer mass [kg] |
|---|---|---|---|---|
| Ox 1 | 327.5 | 18.33 | 21 | 10.85 |
| Ox 2 | 327.5 | 18.33 | 21 | 10.85 |

The oxidizer tanks are well shielded, and the residual pressure in the tanks will be well below their maximum rating. In the narrative portion of this application, SES Americom requests any necessary waiver of Sections 25.114(d)(14)(ii) and 25.283(c) in connection with the residual oxidizer that will remain in these tanks at the end of the satellite's life.

**§ 25.114(d)(14)(iii):**

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.

# APPENDIX 1

# COVERAGE MAPS FOR KA-BAND CONTOURS:

# NOMINAL POINTING

# ***Downlink Contours***

***Figure A1-1: Ka-band spot beam 1A, downlink gain contours, LHCP, Peak EIRP = 60.7 dBW***

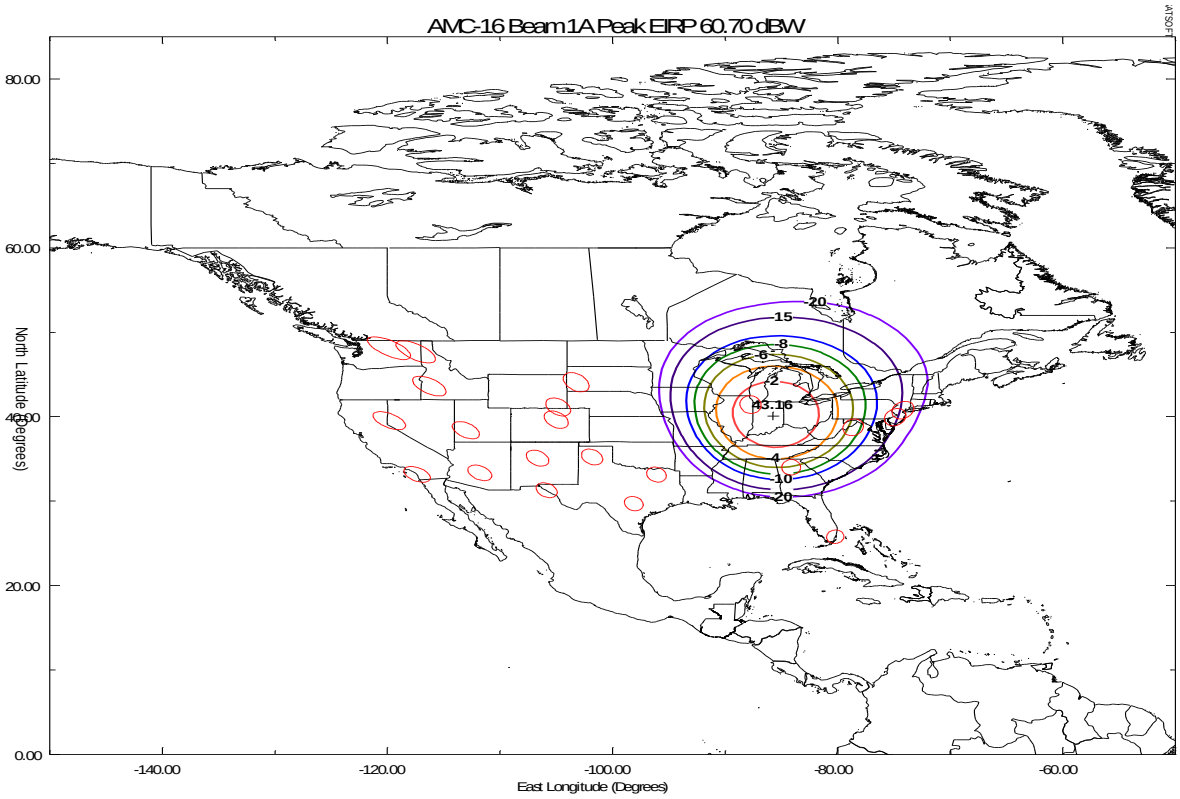


***Figure A1-2: Ka-band spot beam 2B, downlink gain contours, LHCP, Peak EIRP = 61.7 dBW***

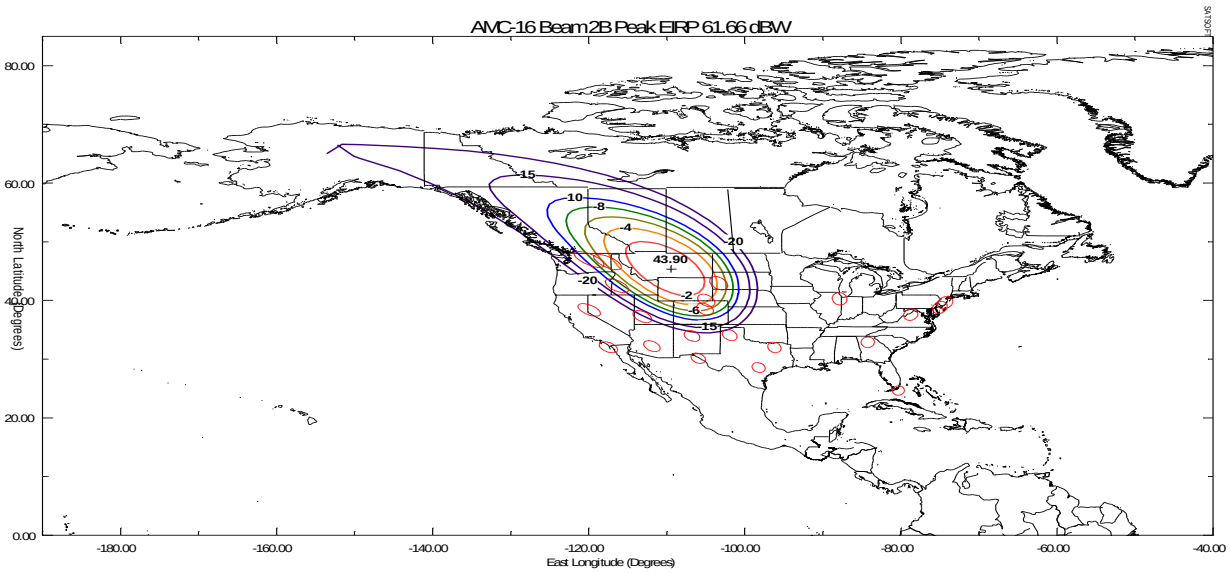


***Figure A1-3: Ka-band spot beam 3A, downlink gain contours, LHCP, Peak EIRP = 62.0 dBW***

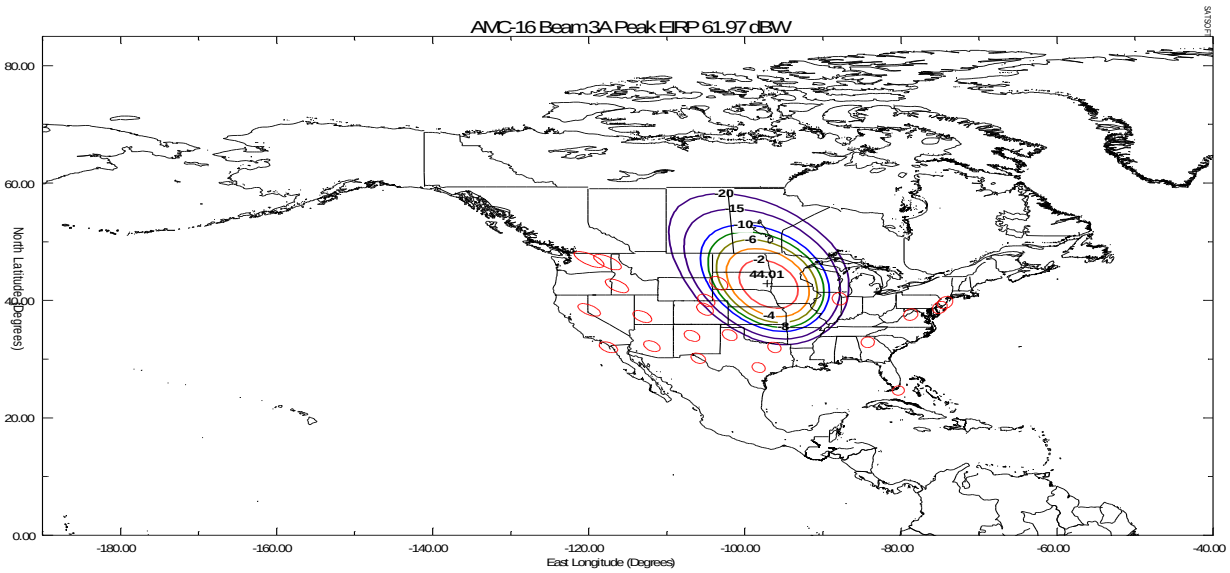


***Figure A1-4: Ka-band spot beam 4A, downlink gain contours, LHCP, Peak EIRP = 61.0 dBW***

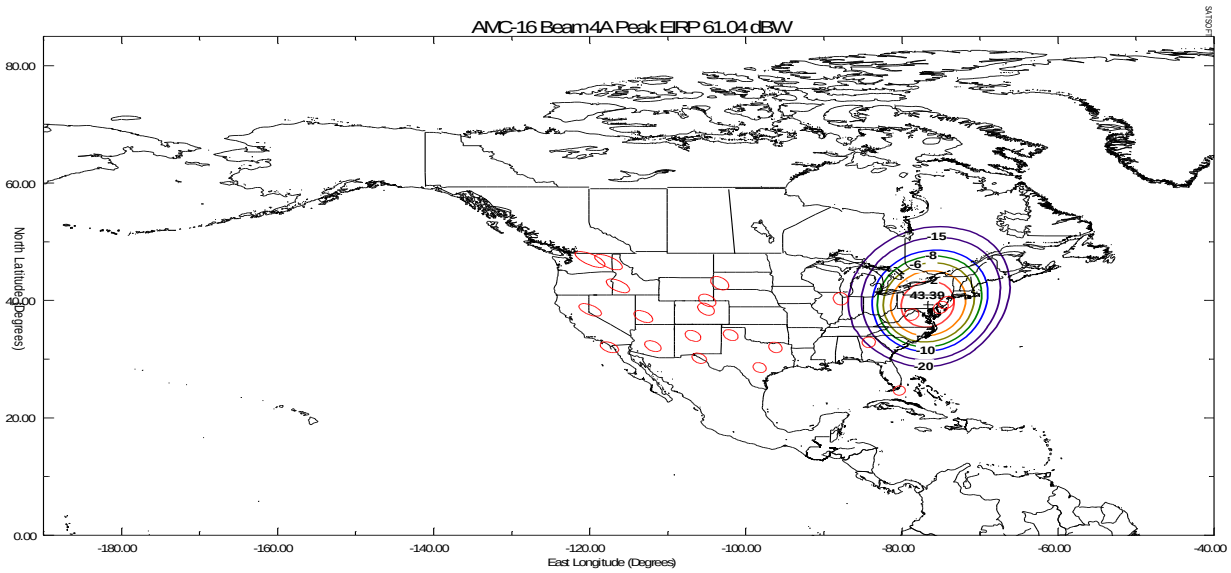


***Figure A1-5: Ka-band spot beam 5B, downlink gain contours, LHCP, Peak EIRP = 61.5 dBW***

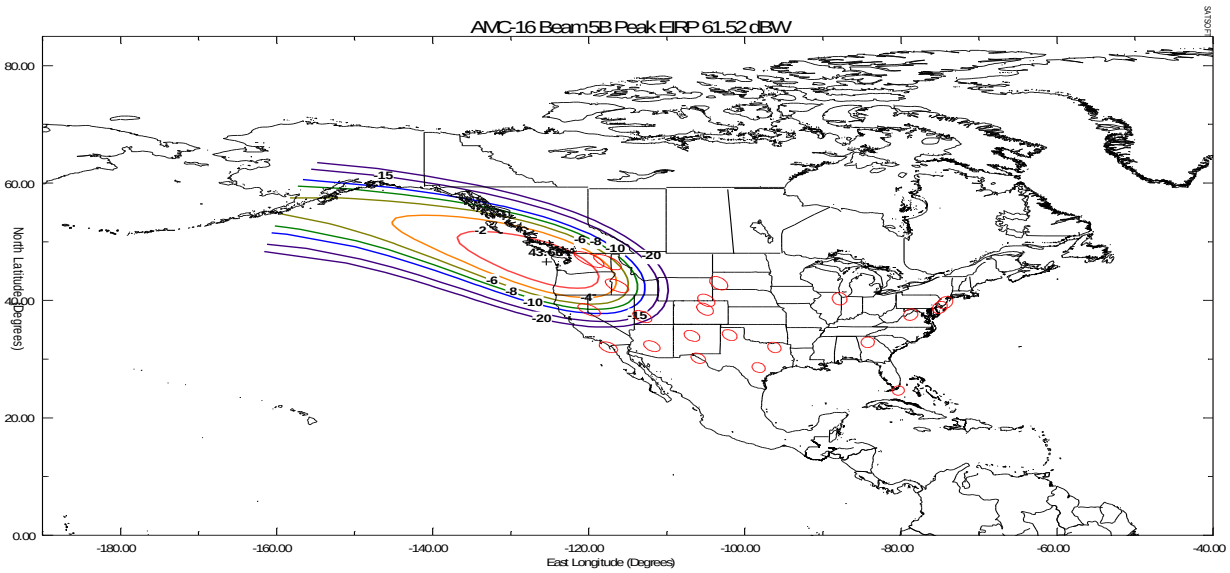


***Figure A1-6: Ka-band spot beam 1B, downlink gain contours, LHCP, Peak EIRP = 61.3 dBW***

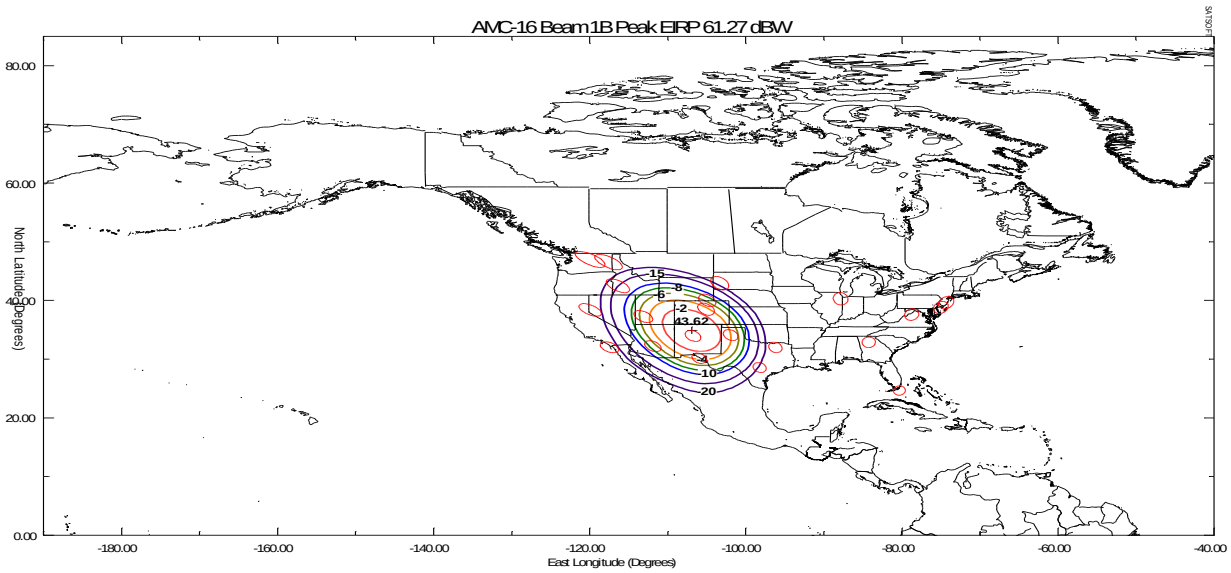


***Figure A1-7: Ka-band spot beam 2A, downlink gain contours, LHCP, Peak EIRP = 61.6 dBW***

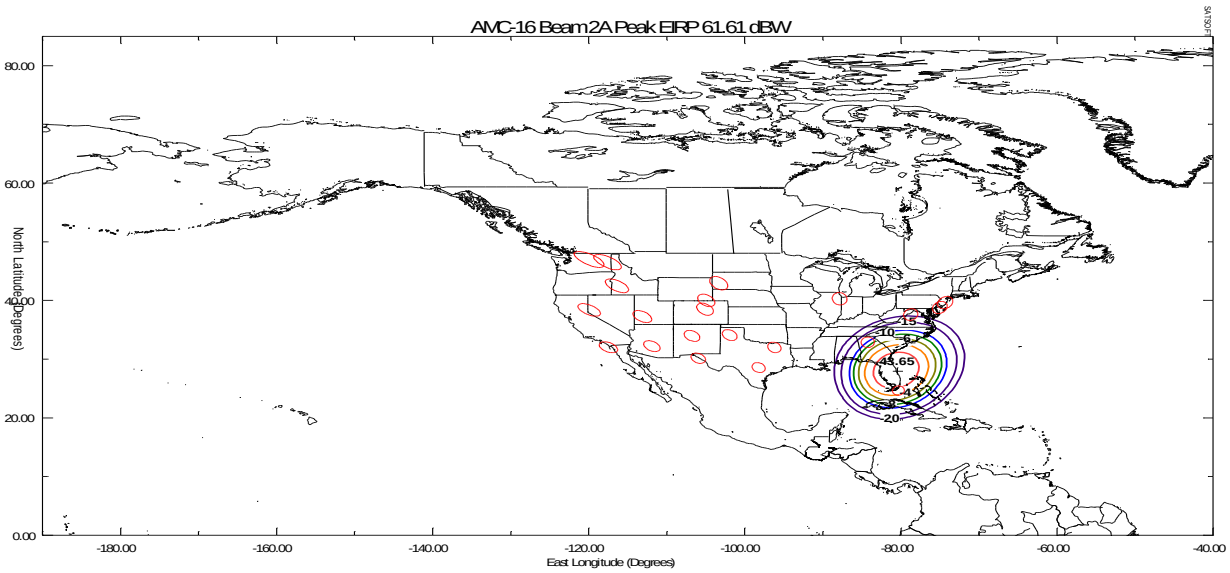


***Figure A1-8: Ka-band spot beam 3B, downlink gain contours, LHCP, Peak EIRP = 61.2 dBW***

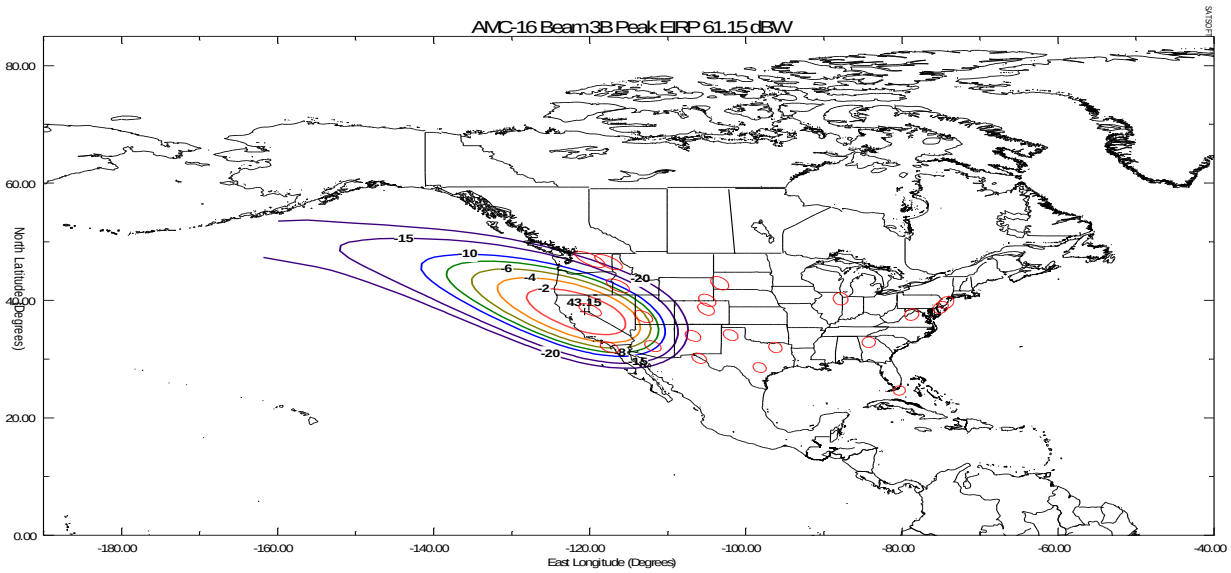


***Figure A1-9: Ka-band spot beam 4B, downlink gain contours, LHCP, Peak EIRP = 61.6 dBW***

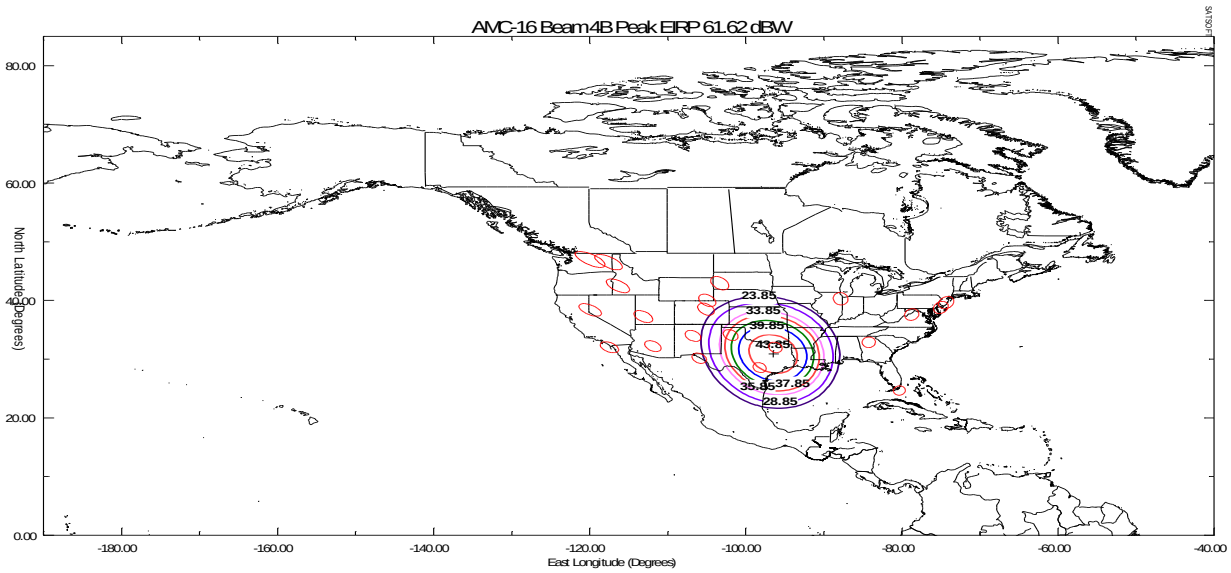
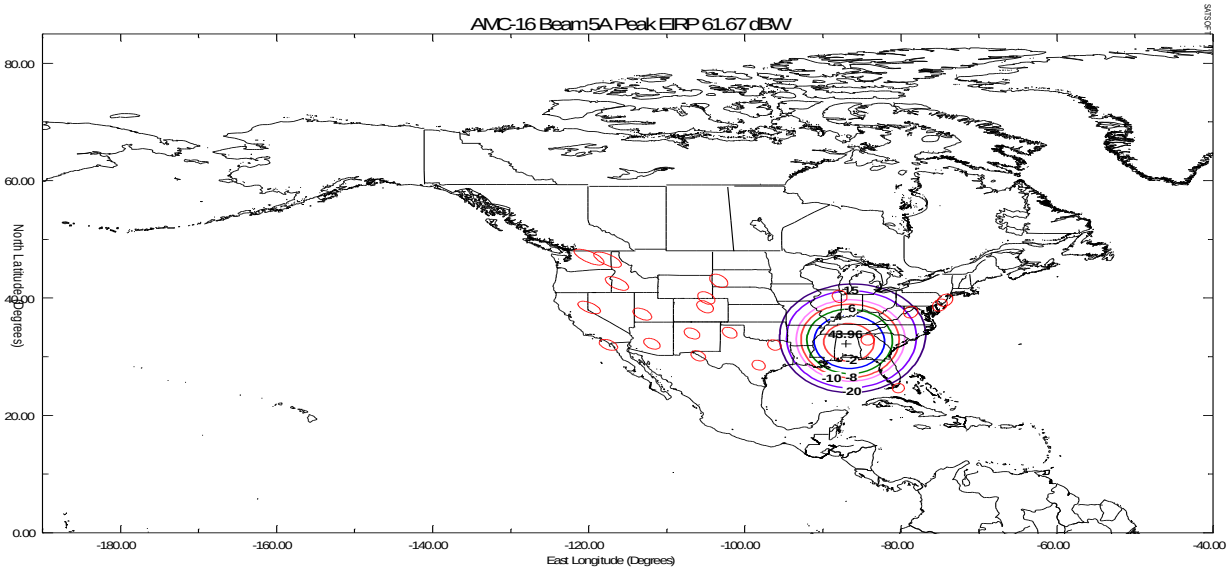


***Figure A1-10: Ka-band spot beam 5A, downlink gain contours, LHCP, Peak EIRP = 61.7 dBW***



# ***Uplink Contours***

***Figure A1-11: Ka-band spot beam 1A, uplink gain contours, RHCP, G/T max = 14.7 dB/K***

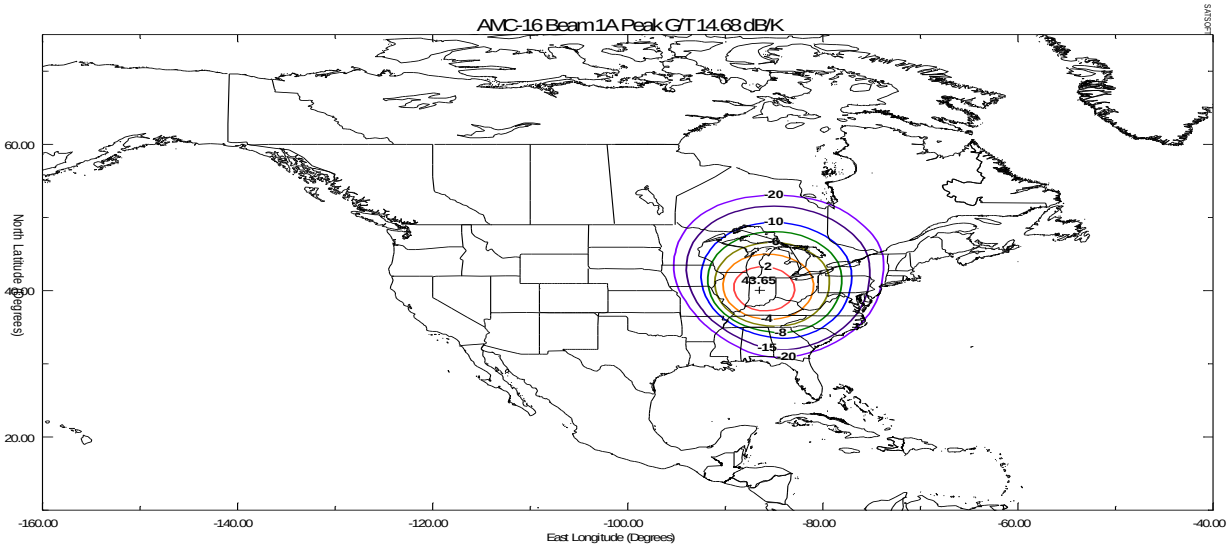


***Figure A1-12: Ka-band spot beam 2B, uplink gain contours, RHCP, G/T max = 15.5 dB/K***

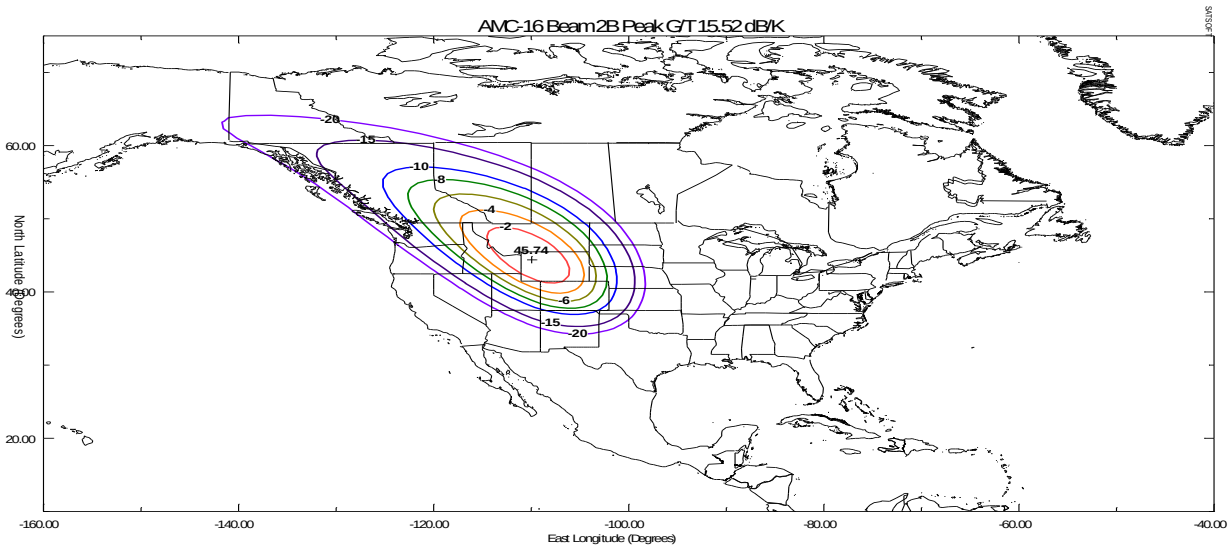


***Figure A1-13: Ka-band spot beam 3A, uplink gain contours, RHCP, G/T max = 14.9 dB/K***

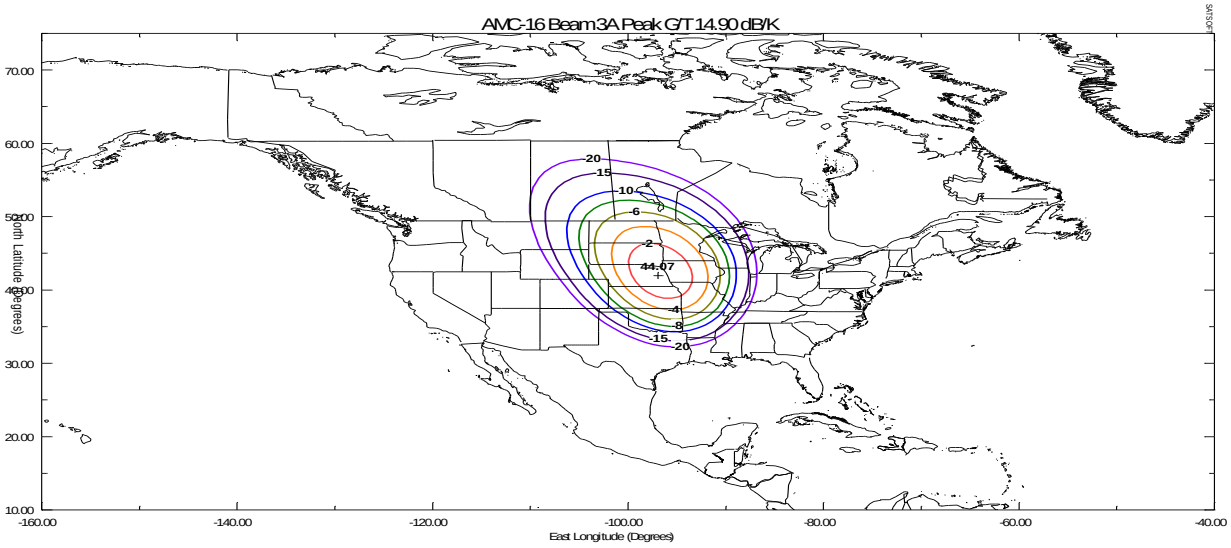


***Figure A1-14: Ka-band spot beam 4A, uplink gain contours, RHCP, G/T max = 15.6 dB/K***

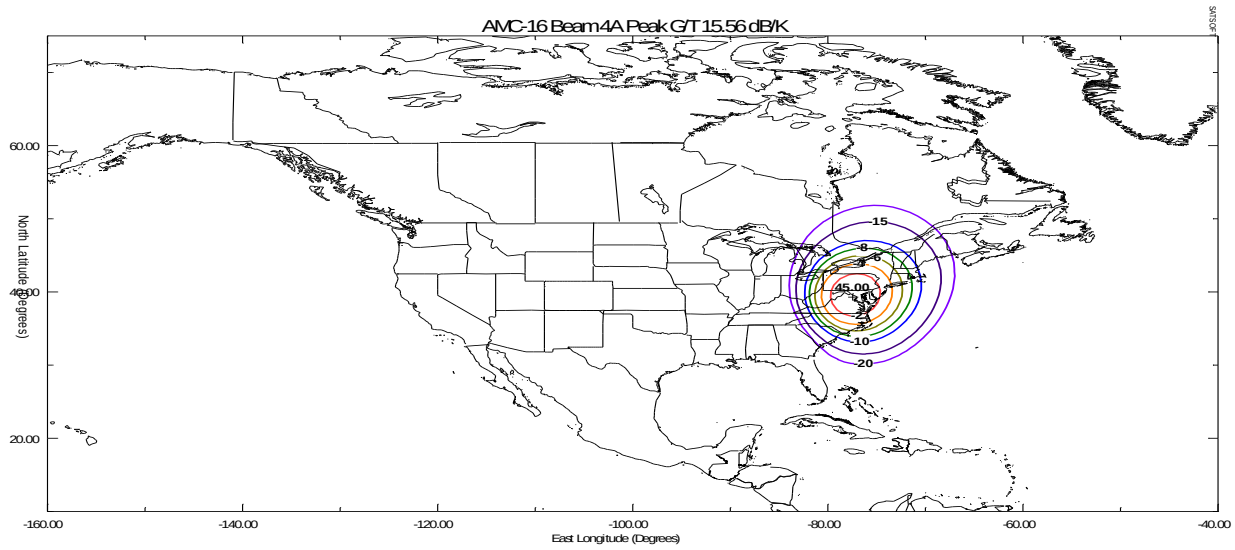


***Figure A1-15: Ka-band spot beam 5B, uplink gain contours, RHCP, G/T max = 15.4 dB/K***

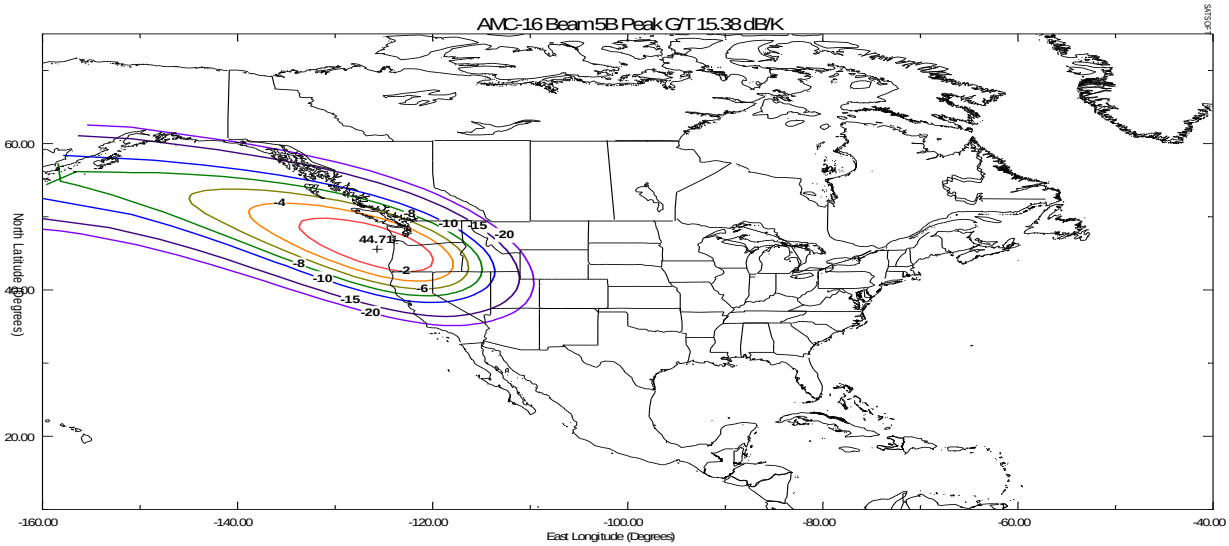


***Figure A1-16: Ka-band spot beam 1B, uplink gain contours, RHCP, G/T max = 14.0 dB/K***

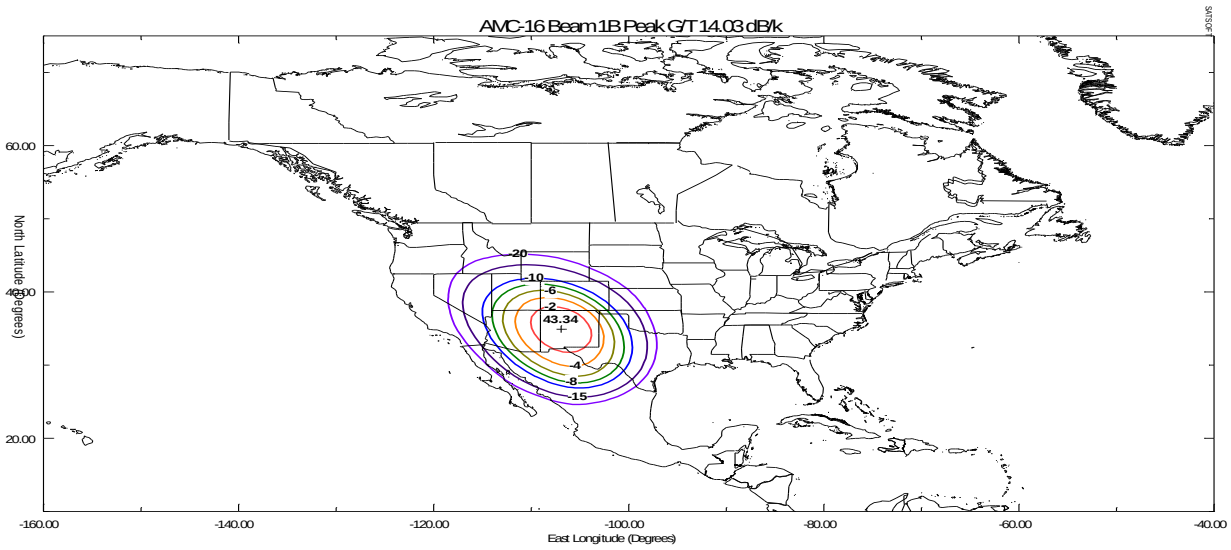


***Figure A1-17: Ka-band spot beam 2A, uplink gain contours, RHCP, G/T max = 16.4 dB/K***

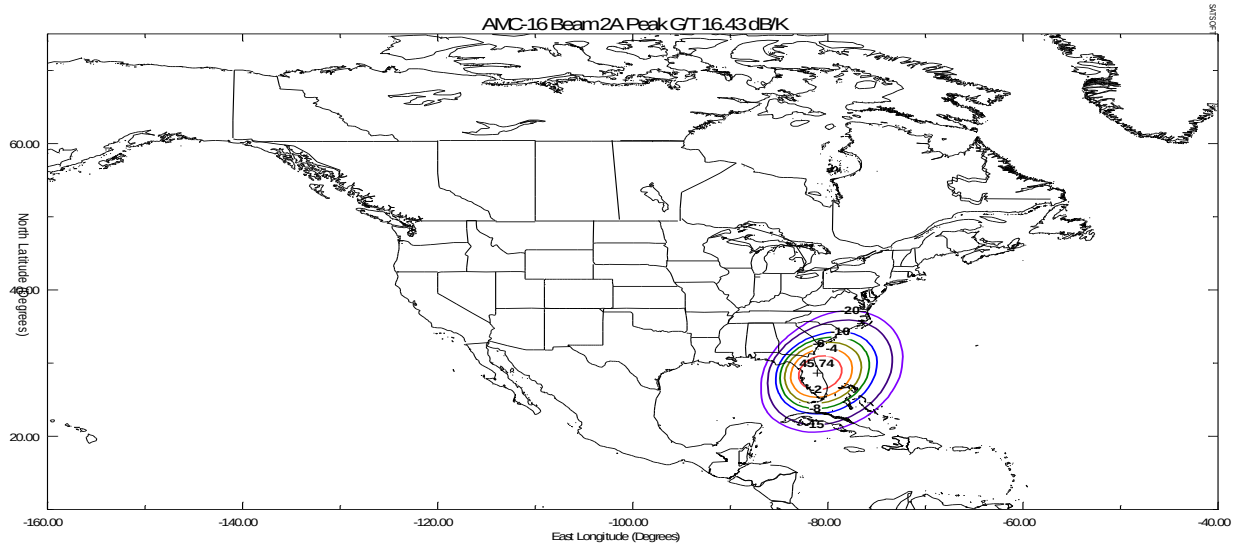


***Figure A1-18: Ka-band spot beam 3B, uplink gain contours, RHCP, G/T max = 14.6 dB/K***

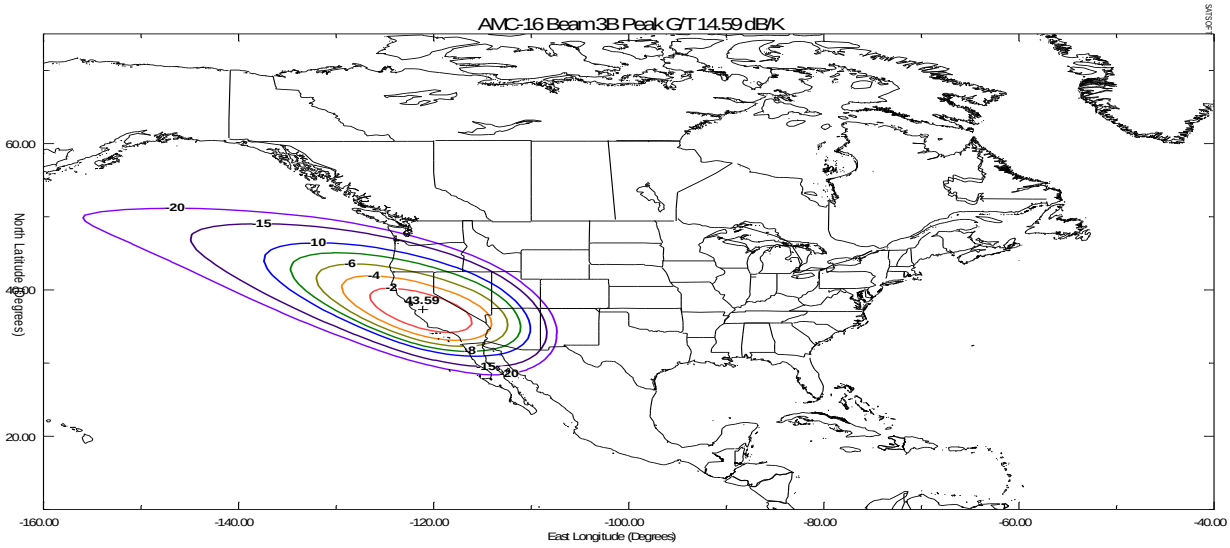


***Figure A1-19: Ka-band spot beam 4B, uplink gain contours, RHCP, G/T max = 15.7 dB/K***

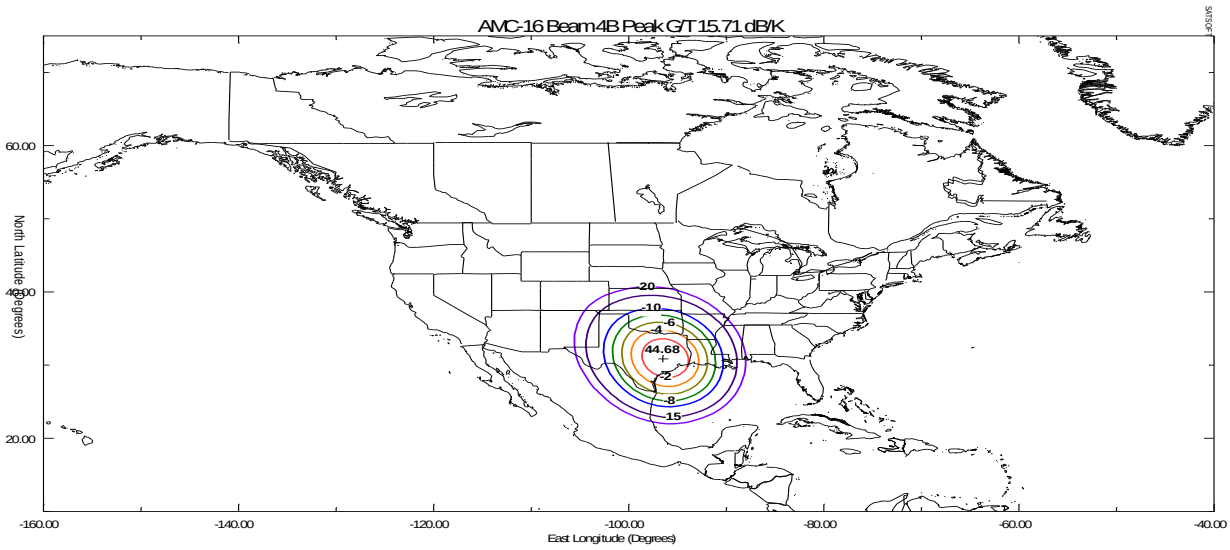
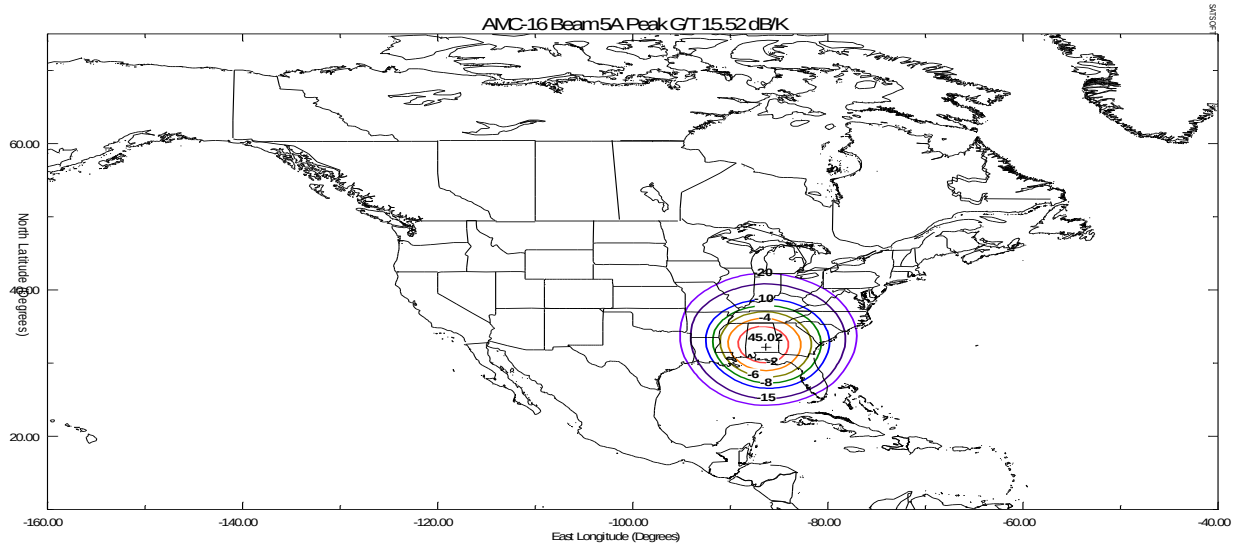


***Figure A1-20: Ka-band spot beam 5A, uplink gain contours, RHCP, G/T max = 15.5 dB/K***



# APPENDIX 2

# SECTION 25.138 ANALYSIS (KA-BAND TWO DEGREE SPACING)

# IN SUPPORT OF AMC-16

## 1. Introduction

Section 25.138 contains off-axis EIRP density limits for Ka-band uplinks (§ 25.138(a)(1)), and pfd limits (§ 25.138(a)(6)). Each of these provisions is addressed below. The limits in Section 25.138 will be met in all cases, so that of the modified coverage of the Ka-band spot beams authorized pursuant to this modification will not adversely affect adjacent satellite operations.

## 2. Off-axis EIRP density limits

Section 25.138(a)(1), together with 25.138(b), specifies that certain EIRP density levels must be met by FSS earth stations, or coordination of the network is necessary with other licensees within +/- 6 degrees of the licensed orbit location.

The following Tables demonstrate that AMC-16, using the uplink EIRP levels and earth station antenna sizes from the sample link budgets in the 2004 Ka-band Filing, Attachment A (Section 2.12), meets these off-axis EIRP density requirements.

Table C-1a. Off-axis EIRP density

| Carrier type | 8PSK DVB S2 60 Mbps | QPSK 3-4 8 Mbps | QPSK 2-3 100Mbps | 8PSK 2-3 73 Mbps | QPSK 1-2 Turbo 1.2Mbps |
|---|---|---|---|---|---|
| Frequency, GHz | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 |
| IF bandwidth, kHz | 32499.8 | 5787.2 | 81383.0 | 39606.4 | 1263.2 |
| Carrier EIRP, dBW | 73.8 | 69.4 | 80.8 | 77.1 | 42.4 |
| Earth station antenna diameter, m | 6.00 | 4.50 | 6.00 | 6.00 | 0.65 |
| EIRP density, dBW/40 kHz | 44.7 | 47.8 | 47.7 | 47.1 | 27.4 |
| On-axis gain of earth station antenna | 63.49 | 60.99 | 63.49 | 63.49 | 44.18 |
| Off-axis gain at 2.1 degrees (topocentric) | 20.94 | 20.94 | 20.94 | 20.94 | 20.94 |
| Off-axis eirp density at 2 degrees, dBW/40 kHz | 2.19 | 7.75 | 5.17 | 4.55 | 4.17 |
| | | | | | |
| FCC 25.138, 18.5-25*log(2.1) dBW/40 kHz | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 |
| Margin | 8.26 | 2.69 | 5.27 | 5.90 | 6.28 |

Table C-1b. Off-axis EIRP density

| Carrier type | QPSK 3/4 DVB S2 52 Mbps | 8PSK 2/3 DVB S2 70 Mbps | 16APSK 3/4 DVB S2 100 Mbps | QPSK 3/4 DVB S2 3 Mbps | 8PSK 2/3 DVB S2 4 Mbps | QPSK 3/4 DVB S2 380 kbps | BPSK 2/3 DVB S2 20 kbps |
|---|---|---|---|---|---|---|---|
| Frequency, GHz | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 |
| IF bandwidth, kHz | 34746.31 | 34578.32 | 34743.91 | 2046.01 | 2036.12 | 255.80 | 31.84 |
| Carrier EIRP, dBW | 72.99 | 72.99 | 72.99 | 47.18 | 47.18 | 41.18 | 32.18 |
| Earth station antenna diameter, m | 8.00 | 8.00 | 8.00 | 0.65 | 0.65 | 0.65 | 0.65 |
| EIRP density, dBW/40 kHz | 43.6 | 43.6 | 43.6 | 30.1 | 30.1 | 33.1 | 33.2 |
| On-axis gain of earth station antenna | 65.99 | 65.99 | 65.99 | 44.18 | 44.18 | 44.18 | 44.18 |
| Off-axis gain at 2.1 degrees (topocentric) | 20.94 | 20.94 | 20.94 | 20.94 | 20.94 | 20.94 | 20.94 |
| Off-axis eirp density at 2 degrees, dBW/40 kHz | -1.44 | -1.42 | -1.44 | 6.85 | 6.87 | 9.88 | 9.93 |
| | | | | | | | |
| FCC 25.138, 18.5-25*log(2.1) dBW/40 kHz | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 | 10.44 |
| Margin | 11.89 | 11.87 | 11.89 | 3.59 | 3.57 | 0.56 | 0.51 |

## 3. PFD limits

Section 25.138(a)(6), together with 25.138(b), specifies that certain power flux density (PFD) levels must be met by FSS space stations, or coordination of the space station is necessary with other licensees within +/- 6 degrees of the licensed orbit location.

The following Table demonstrates that AMC-16, using the maximum Ka-band EIRP levels in the 2004 Ka-band Filing, Attachment A (Section 2.1.2), meets these PFD requirements.

Table C-2. AMC-16 Worst Case PFD analysis

| | |
|---|---|
| Maximum EIRP, dBW | 62.0 |
| IF Bandwidth, dBHz | 79.1 |
| 1 MHz, dBHz | 60.0 |
| Minimum spreading loss, dBW/m2 | 162.1 |
| Maximum PFD, dBW/m2/1 MHz | -119.3 |
| 25.138 level, dBW/m2/ 1MHz | -118 |
| Margin, dB | 1.3 |

In addition, Tables C-3a and C-3b provide a PFD analysis for the sample link budgets provided in the 2004 Ka-band Filing, Attachment A (Section 2.12).

| Table C-3a. PFD calculations for Sample Link budgets | | | | | |
|---|---|---|---|---|---|
| Carrier type | 8PSK DVB S2 60 Mbps | QPSK 3-4 8 Mbps | QPSK 2-3 100Mbps | 8PSK 2-3 73 Mbps | QPSK 1-2 Turbo 1.2Mbps |
| Frequency, GHz | 19.7 | 19.7 | 19.7 | 19.7 | 19.7 |
| Data rate, kbps | 59901.5 | 8000.0 | 100000.0 | 73000.0 | 1200.0 |
| Modulation phases | 8.0 | 4.0 | 4.0 | 8.0 | 4.0 |
| FEC | 2/3 | 3/4 | 2/3 | 2/3 | 1/2 |
| Outer coding | 188/204 | 188/204 | 188/204 | 188/204 | 0.95 |
| IF bandwidth, kHz | 32499.8 | 5787.2 | 81383.0 | 39606.4 | 1263.2 |
| Carrier EIRP, dBW | 50.3 | 42.6 | 59.1 | 52.3 | 17.6 |
| Minimum spreading loss, dB/m2 | 162.1 | 162.1 | 162.1 | 162.1 | 162.1 |
| | | | | | |
| PFD, dBW/m2/1 MHz | -126.9 | -127.1 | -122.1 | -125.8 | -145.5 |
| | | | | | |
| FCC 25.208 PFD limit, dBW/m2/1 MHz | -115.0 | -115.0 | -115.0 | -115.0 | -115.0 |
| Margin | 11.9 | 12.1 | 7.1 | 10.8 | 30.5 |
| | | | | | |
| FCC 25.138 PFD limit, dBW/m2/1 MHz | -118.0 | -118.0 | -118.0 | -118.0 | -118.0 |
| Margin | 8.91 | 9.14 | 4.12 | 7.85 | 27.53 |

| Table C-3b. PFD calculations for Sample Link budgets | | | | | | | |
|---|---|---|---|---|---|---|---|
| Carrier type | QPSK 3/4 DVB S2 52 Mbps | 8PSK 2/3 DVB S2 70 Mbps | 16APSK 3/4 DVB S2 100 Mbps | QPSK 3/4 DVB S2 3 Mbps | 8PSK 2/3 DVB S2 4 Mbps | QPSK 3/4 DVB S2 380 kbps | BPSK 2/3 DVB S2 20 kbps |
| Frequency, GHz | 19.7 | 19.7 | 19.7 | 19.7 | 19.7 | 19.7 | 19.7 |
| Data rate, kbps | 52119.5 | 69502.4 | 104231.7 | 3069.0 | 4092.6 | 383.7 | 21.3 |
| Modulation phases | 4.0 | 8.0 | 16.0 | 4.0 | 8.0 | 4.0 | 2.0 |
| FEC | 3/4 | 2/3 | 3/4 | 3/4 | 2/3 | 3/4 | 2/3 |
| IF bandwidth, kHz | 34746.3 | 34751.2 | 34743.9 | 2046.0 | 2046.3 | 255.8 | 32.0 |
| Carrier EIRP, dBW | 53.0 | 53.0 | 53.0 | 36.2 | 36.2 | 30.2 | 21.2 |
| Minimum spreading loss, dB/m2 | 162.1 | 162.1 | 162.1 | 162.1 | 162.1 | 162.1 | 162.1 |
| | | | | | | | |
| PFD, dBW/m2/1 MHz | -124.5 | -124.5 | -124.5 | -129.0 | -129.0 | -126.0 | -126.0 |
| | | | | | | | |
| FCC 25.208 PFD limit, dBW/m2/1 MHz | -115.0 | -115.0 | -115.0 | -115.0 | -115.0 | -114.0 | -113.0 |
| Margin | 9.5 | 9.5 | 9.5 | 14.0 | 14.0 | 12.0 | 13.0 |
| | | | | | | | |
| FCC 25.138 PFD limit, dBW/m2/1 MHz | -118.0 | -118.0 | -118.0 | -118.0 | -118.0 | -117.0 | -116.0 |
| Margin | 6.53 | 6.53 | 6.53 | 11.05 | 11.05 | 9.02 | 9.99 |

**Engineering Declaration**

DECLARATION OF ROGER LECLAIR

I, Roger LeClair, 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/_____

Roger LeClair

President, LeClair Telecom

Dated: December 24, 2012