

# Engineering Statement

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## 1 Introduction

Intelsat License LLC (“Intelsat”) seeks authority in this application to operate the satellite designated as Galaxy 11 from 44.9° E.L.

The characteristics of the Galaxy 11 spacecraft, as well as its compliance with the various provisions of Part 25 of the Federal Communications Commission’s (“FCC or “Commission”) rules, are provided in the remainder of this Engineering Statement, which updates the beam gain contours. In all other respects, the characteristics of Galaxy 11 are the same as those described in SAT-MOD-20121018-00184.

## 2 Spacecraft Overview

Galaxy 11 is a Boeing 702 spacecraft that is capable of operating in C-band and Ku-band frequencies listed below.

| Direction | Frequency         |
|-----------|-------------------|
| Uplink    | 5925 – 6425 MHz   |
|           | 13750 – 14500 MHz |
| Downlink  | 3700 – 4200 MHz   |
|           | 10950 – 11200 MHz |
|           | 11700 – 12200 MHz |

The spacecraft provides the following coverage:

| Beam         | Coverage                   |
|--------------|----------------------------|
| Northern     | Northern Africa and Europe |
| South Africa | Southern Africa            |

### 2.1 Spacecraft Characteristics

Galaxy 11 is a Boeing 702 three-axis stabilized type spacecraft that has a rectangular outer body structure. Galaxy 11 utilizes two deployable solar array wings and a number of deployable and non-deployable antennas.

The Galaxy 11 spacecraft is composed of the following subsystems:

- Thermal
- Power

- Attitude Control
- Propulsion
- Telemetry, Command and Ranging
- Uplink Power Control
- Communications

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

The structural design of Galaxy 11 provides mechanical support for all subsystems. The structure supports the communication antennas, solar arrays, and thrusters. It also provides a stable platform for preserving the alignment of critical elements of the spacecraft.

## **2.2 Communication Subsystem**

Galaxy 11 provides active communication channels at C-band and Ku-band frequencies, each having a bandwidth of 36 MHz. The Galaxy 11 frequencies, polarization, and channel plan are provided in Schedule S.

The coverage contours and performance characteristics of Galaxy 11 beams are provided in Schedule S. Exhibits 1 and 2 provide the beam parameters for the Galaxy 11 uplink and downlink beams, respectively.

## **2.3 Telemetry, Command and Ranging Subsystem**

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

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

The Galaxy 11 command and telemetry channel frequencies are shown in Exhibit 3. The coverage patterns of the on-station command and telemetry beams are provided in Schedule S. The coverage patterns of the emergency command and telemetry beams have gain contours that vary by less than 8 dB across the surface of the Earth and accordingly the gain at 8 dB below the peak falls beyond the edge of the Earth. Therefore, pursuant to Section 25.114(c)(4)(vi)(A) of the FCC’s rules, contours for these beams are not required to be provided and the associated GXT files have not been included in Schedule S. The Galaxy 11 command and telemetry subsystem performance is summarized in Exhibit 3.

## **2.4 Uplink Power Control Subsystem**

Galaxy 11 utilizes three Ku-band channels for uplink power control (“ULPC”), antenna tracking, and ranging. The coverage patterns of the UPCC beam is provided in Schedule S. The coverage patterns of the UPGH and UPGV beams have gain contours that vary by less than 8 dB across the surface of the Earth and accordingly the gain at 8 dB below the peak falls beyond the edge of the Earth. Therefore, pursuant to Section 25.114(c)(4)(vi)(A) of the FCC’s rules, contours for these beams are not required to be provided and the associated GXT files have not been included in Schedule S. The Galaxy 11 ULPC frequencies and subsystem performance are summarized in Exhibit 3.

## **2.5 Satellite Station-Keeping**

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

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

## **3 Services**

Galaxy 11 is a general purpose communications satellite and has been designed to support various services offered within the Intelsat satellite system. Depending upon the needs of the users, the transponders on Galaxy 11 can accommodate television, radio, voice, and data communications. Typical communication services include:

- a) Compressed digital video
- b) High speed digital data
- c) Digital single channel per carrier (“SCPC”) data channels

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

## **4 Power Flux Density**

The power flux density (“PFD”) limits for space stations operating in the 3700 – 4200 MHz and 10950 – 11200 MHz bands are contained in Section 25.208 of the Commission’s rules. Neither the Commission’s rules nor the ITU Radio Regulations specify any PFD limits for the 11700 – 12200 MHz band applicable to geostationary satellites operating in the fixed satellite service.

The maximum PFD levels for the Galaxy 11 transmissions were calculated for the 3700 – 4200 MHz, 10950 – 11200 MHz, and 11700 – 12200 MHz bands. The results are provided in Schedule S and show that the downlink power flux density levels of the Galaxy 11 carriers do not exceed the limits specified in Section 25.208 of the Commission’s rules.

## **5 Emission Compliance**

Section 25.202(e) of the Commission’s rules requires that the carrier frequency of each space station transmitter be maintained within 0.002% of the reference frequency. Galaxy 11 is designed to be compliant with the provisions of this rule.

Intelsat will comply with the provisions of Section 25.202(f) of the Commission’s rules with regard to Galaxy 11 emissions.

## **6 Orbital Location**

Intelsat requests that it be assigned the 44.9° E.L. orbital location for Galaxy 11. The 44.9° E.L. location satisfies Galaxy 11 requirements for optimizing coverage, elevation angles, and service availability. Additionally, the location also ensures that the maximum operational, economic, and public interest benefits will be derived.

## **7 Coordination with Co-frequency Space Stations**

The impact of the Galaxy 11 emissions on hypothetical adjacent satellites located at 42.9° E.L. and 46.9° E.L. was analyzed.<sup>1</sup> The interference analysis was conducted for a number of representative carriers at C-band and Ku-band frequencies. It was assumed that there were hypothetical satellites having the same operating characteristics as Galaxy 11 at the 42.9° E.L. and 46.9° E.L. orbital locations.

For the satellite located at 46.9° E.L., it was assumed that the adjacent satellites were Galaxy 11, located at 44.9° E.L., and a hypothetical satellite having the same operating characteristics as Galaxy 11 located at 48.9° E.L.<sup>2</sup> For the satellite located at 42.9° E.L., it was assumed that the adjacent satellites were Galaxy 11, located at 44.9° E.L., and a hypothetical satellite having the

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<sup>1</sup> At the time of submission of this application, there are no satellites located at 42.9° E.L. or 46.9° E.L. The use of satellites at other locations the interference analysis would be inconsistent with a two-degree orbital separation environment and policy.

<sup>2</sup> At the time of submission of this application, there are no satellites located at 48.9° E.L. The use of satellites at other locations the interference analysis would be inconsistent with a two-degree orbital separation environment and policy.

same operating characteristics as Galaxy 11 located at 40.9° E.L.<sup>3</sup> Since the interference situation for the hypothetical satellite located at 42.9° E.L. is identical to the interference situation of the hypothetical satellite at 46.9° E.L., link budgets are included herein for only the 42.9° E.L. satellite.

Other assumptions made for the interference analysis were as follows:

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

All assumptions and the results of the analysis are documented in Exhibit 5. The Galaxy 11 transmissions will comply with the levels contained in Sections 25.212(c) and (d) and Section 25.138 of the Commission's rules, as applicable, unless higher levels are coordinated with affected adjacent satellite operators within  $\pm 6^\circ$ .

## **8 Orbital Debris Mitigation Plan**

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

### **8.1 Spacecraft Hardware Design**

The spacecraft is designed such that no debris will be released during normal operations. Intelsat has assessed the probability of collision with meteoroids and other small debris (<1 cm diameter) and has taken the following steps to limit the effects of such collisions: (1) critical spacecraft components are located inside the protective body of the spacecraft and properly shielded; and (2) all spacecraft subsystems have redundant components to ensure no single-point failures. The

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<sup>3</sup> At the time of submission of this application, there are no satellites located at 40.9° E.L. The use of satellites at other locations the interference analysis would be inconsistent with a two-degree orbital separation environment and policy.

spacecraft does not use any subsystems for end-of-life disposal that are not used for normal operations.

## **8.2 Minimizing Accidental Explosions**

Intelsat has assessed the probability of accidental explosions during and after completion of mission operations. The spacecraft is designed in a manner to minimize the potential for such explosions. Propellant tanks and thrusters are isolated using redundant valves and electrical power systems are shielded in accordance with standard industry practices. At the completion of the mission and upon disposal of the spacecraft, Intelsat will ensure that all active units are turned off. However, due to the design of Galaxy 11, Intelsat will not be able to vent all pressurized systems. Intelsat previously received waiver of Section 25.283(c) of the Commission's rules, 47 C.F.R. § 25.283.<sup>4</sup>

## **8.3 Safe Flight Profiles**

Intelsat has assessed and limited the probability of the space station becoming a source of debris as a result of collisions with large debris or other operational space stations. Subject to receipt of FCC approval, Galaxy 11 will first be drifted to 45.0 E.L. and will temporarily be operated co-located with Intelsat 12 until completion of traffic transition.<sup>5</sup> After traffic transition and subject to receipt of FCC approval, Galaxy 11 will be relocated to 44.9°E.L. Once relocated to 44.9° E.L., Galaxy 11 will not be located at an orbital location that has an overlapping station-keeping volume with another satellite.

During the relocation of Galaxy 11, Intelsat will take all the necessary steps to coordinate the move internally to minimize the risk of collision or interference between Galaxy 11 and Intelsat 12. Intelsat is not aware of any other FCC licensed system, or any other system applied for and under consideration by the FCC, that will have an overlapping station-keeping volume with Galaxy 11. Intelsat is also not aware of any system with an overlapping station-keeping volume with Galaxy 11 that is the subject of an ITU filing and that is either in orbit or progressing towards launch.

## **8.4 Post Mission Disposal**

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<sup>4</sup> See Application to Modify Authorization for Galaxy 11 (S2253), File No. SAT-MOD-20101102-00229 (Stamp Grant Mar. 8, 2011, as corrected Apr. 7, 2011).

<sup>5</sup> Intelsat has sought Special Temporary Authority for the temporary stop at 45.0° E.L. See *Policy Branch Information; Satellite Space Applications Accepted for Filing*, Report No. SAT-01172, File No. SAT-STA-20160623-00059 (Jul. 8, 2016).

At the end of the mission, Intelsat intends to dispose of the spacecraft by moving it to an altitude of at least 175 kilometers above the geostationary arc as previously stated.<sup>6</sup> Intelsat has reserved 30.035 kilograms of fuel for this purpose. In its *Second Report and Order* in IB Docket 02-54, Mitigation of Orbital Debris,<sup>7</sup> the FCC declared that satellites launched prior to March 18, 2002, such as the Galaxy 11 satellite, would be designated as grandfathered satellites not subject to a specific disposal altitude. Therefore, the planned disposal orbit for Galaxy 11, as revised, complies with the FCC's rules.

The reserved fuel figure was determined by the spacecraft manufacturer and provided for in the propellant budget. This figure was calculated taking into account the expected mass of the satellite at the end of life and the required delta-velocity to achieve the desired orbit. The fuel gauging uncertainty has been taken into account in these calculations.

## **9 TC&R Control Earth Stations**

Intelsat will conduct TC&R operations through one or more of the following earth stations: Fuchsstadt, Germany; Hartebeeshoek, South Africa; Mingenew, Australia; Kumsan, South Korea; or Fucino, Italy. Additionally, Intelsat is capable of remotely controlling Galaxy 11 from its facilities in McLean, VA or in Long Beach, CA.

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<sup>6</sup> See Request for Special Temporary Authority to Drift Galaxy 11 to, and Operate at, 60.1° E.L. and Notification of Revised Post-mission Disposal Statement; Call Sign: S2253, File No. SAT-STA-20150505-00033 (filed May 5, 2015).

<sup>7</sup> Mitigation of Orbital Debris, *Second Report and Order*, 19 FCC Rcd 11567 (2004).

# Certification Statement

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

/s/ Alan Yates

August 3, 2016

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Alan Yates

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Date

Intelsat

Senior Manager, Spectrum  
Engineering



## EXHIBIT 1

### COMMUNICATION SUBSYSTEM UPLINK BEAM PARAMETERS

| Beam Name                                | C-Band             | C-Band             | Ku-Band Europe       | Ku-Band Europe       |
|--|--------------------|--------------------|----------------------|----------------------|
| <b>Schedule S Beam ID</b>                | CHUL               | CVUL               | KHUL                 | KVUL                 |
| <b>Frequency Band (MHz)</b>              | <b>5925 – 6425</b> | <b>5925 – 6425</b> | <b>14000 - 14500</b> | <b>14000 - 14500</b> |
| <b>Polarization</b>                      | Horizontal         | Vertical           | Horizontal           | Vertical             |
| <b>G/T (dB/K)</b>                        | 2.5                | 4.2                | 6.3                  | 4.8                  |
| <b>Minimum SFD-- (dBW/m<sup>2</sup>)</b> | -94.0              | -95.2              | -99.8                | -98.3                |
| <b>Maximum SFD-- (dBW/m<sup>2</sup>)</b> | -80.0              | -81.2              | -83.8                | -82.3                |

| Beam Name                                | Ext. Ku-Band Europe  | Ext. Ku-Band Europe  | Ku-Band South Africa | Ku-Band South Africa |
|--|----------------------|----------------------|----------------------|----------------------|
| <b>Schedule S Beam ID</b>                | EHUL                 | EVUL                 | BHUL                 | BVUL                 |
| <b>Frequency Band (MHz)</b>              | <b>13750 - 14000</b> | <b>13750 - 14000</b> | <b>14000 - 14500</b> | <b>14000 - 14500</b> |
| <b>Polarization</b>                      | Horizontal           | Vertical             | Horizontal           | Vertical             |
| <b>G/T (dB/K)</b>                        | 5.2                  | 5.2                  | 5.7                  | 6.3                  |
| <b>Minimum SFD-- (dBW/m<sup>2</sup>)</b> | -94.3                | -94.2                | -98.3                | -99.9                |
| <b>Maximum SFD-- (dBW/m<sup>2</sup>)</b> | -78.3                | -78.2                | -82.3                | -83.9                |

## EXHIBIT 2

### COMMUNICATION SUBSYSTEM DOWNLINK BEAM PARAMETERS

| Beam Name  | C-Band      | C-Band      | Ku-Band Europe | Ku-Band Europe |
|--|-------------|-------------|----------------|----------------|
| <b>Schedule S Beam ID</b>                        | CHDL        | CVDL        | KHDL           | KVDL           |
| <b>Frequency Band (MHz)</b>                      | 3700 - 4200 | 3700 - 4200 | 11700 - 12200  | 11700 - 12200  |
| <b>Polarization</b>                              | Horizontal  | Vertical    | Horizontal     | Vertical       |
| <b>EIRP (dBW)</b>                                | 40.2        | 40.1        | 49.7           | 49.7           |
| <b>Maximum Beam Peak EIRP Density (dBW/4kHz)</b> | 1.4         | 1.3         | 10.9           | 10.9           |

| Beam Name  | Ext. Ku-Band Europe | Ext. Ku-Band Europe | Ku-Band South Africa | Ku-Band South Africa |
|--|---------------------|---------------------|----------------------|----------------------|
| <b>Schedule S Beam ID</b>                        | EHDL                | EVDL                | BHDL                 | BVDL                 |
| <b>Frequency Band (MHz)</b>                      | 10950 - 11200       | 10950 - 11200       | 11700 - 12200        | 11700 - 12200        |
| <b>Polarization</b>                              | Horizontal          | Vertical            | Horizontal           | Vertical             |
| <b>EIRP (dBW)</b>                                | 52.1                | 52.0                | 52.5                 | 51.9                 |
| <b>Maximum Beam Peak EIRP Density (dBW/4kHz)</b> | 14.3                | 14.2                | 13.7                 | 13.1                 |

## EXHIBIT 3

### TC&R SUBSYSTEM CHARACTERISTICS

| Beam Name  | Command Europe | Command Bicone | Command Pipe |
|--|----------------|----------------|--------------|
| <b>Schedule S Beam ID</b>  | CMDC           | CMDB           | CMDP         |
| <b>Frequencies (MHz)</b>   | 14498.5        | 14498.5        | 14000.5      |
| <b>Polarization</b>  | Vertical       | Horizontal     | LHCP         |
| <b>Peak Flux Density at Command Threshold (dBW/m<sup>2</sup>-Hz)</b> | -119.6         | -91.8          | -94.3        |

| Beam Name  | Telemetry Europe     | Telemetry Bicone     | Telemetry Pipe       | ULPC Europe | ULPC                     |
|--|----------------------|----------------------|----------------------|-------------|--------------------------|
| <b>Schedule S Beam ID</b>                        | TLMC                 | TLMB                 | TLMP                 | UPCC        | UPGH/<br>UPGV            |
| <b>Frequencies (MHz)</b>                         | 11701.0 &<br>11702.0 | 11701.0 &<br>11702.0 | 11701.0 &<br>11702.0 | 12195.0     | 10951.0                  |
| <b>Polarization</b>                              | Vertical             | Vertical             | LHCP                 | Horizontal  | Horizontal<br>& Vertical |
| <b>Maximum Channel EIRP (dBW)</b>                | 15.3                 | 11.6                 | 11.6                 | 25.3        | 19.1                     |
| <b>Maximum Beam Peak EIRP Density (dBW/4kHz)</b> | -3.5                 | -7.2                 | -7.2                 | 17.3        | 11.1                     |

*Note: RHCP: Right Hand Circular Polarization, LHCP: Left Hand Circular Polarization*

**EXHIBIT 4**  
**Beam Polarizations and GXT File Names**

| Schedule S Beam Names |                     |          |          |          |                       |        |          |          |
|-----------------------|---------------------|----------|----------|----------|-----------------------|--------|----------|----------|
| Beam Designation      | Linear Polarization |          |          |          | Circular Polarization |        |          |          |
|                       | Uplink              | Uplink   | Downlink | Downlink | Uplink                | Uplink | Downlink | Downlink |
|                       | (H-Pol.)            | (V-Pol.) | (H-Pol.) | (V-Pol.) | (LHCP)                | (RHCP) | (LHCP)   | (RHCP)   |
| C-Band Beams          |                     |          |          |          |                       |        |          |          |
| C-band Europe         | CHUL                | CVUL     | CHDL     | CVDL     | ----                  | ----   | ----     | ----     |
| Ku-band Europe        | KHUL                | KVUL     | KHDL     | KVDL     | ----                  | ----   | ----     | ----     |
| Ext. Ku-band Europe   | EHUL                | EVUL     | EHDL     | EVDL     | ----                  | ----   | ----     | ----     |
| South                 | BHUL                | BVUL     | BHDL     | BVDL     | ----                  | ----   | ----     | ----     |
| Ku-Band Beams         |                     |          |          |          |                       |        |          |          |
| Telemetry Northern    | ----                | ----     | ----     | TLMC     |                       |        |          | ----     |
| Telemetry Pipe        | ----                | ----     | ----     | ----     | ----                  | ----   | TLMP*    |          |
| Telemetry Bicone      | ----                | ----     | ----     | TLMB*    | ----                  | ----   | ----     |          |
| Command Northern      |                     | CMDC     | ----     | ----     |                       | ----   | ----     | ----     |
| Command Bicone        | CMDB                | ----     | ----     | ----     | CMDB*                 | ----   | ----     | ----     |
| Command Pipe          |                     |          |          |          | CMDP*                 |        |          |          |
| Ku-band ULPC Europe   | ----                | ----     | UPCC     |          | ----                  | ----   | ----     | ----     |
| ULPC Global           |                     |          | UPGH*    | UPGV*    |                       |        |          |          |

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

## EXHIBIT 5: HYPOTHETICAL 42.9°E.L. SATELLITE INTERFERENCE ANALYSIS

|  |                     |                     |                     |
|--|---------------------|---------------------|---------------------|
| <b>UPLINK BEAM INFORMATION</b>           |                     |                     |                     |
| Uplink Beam Name                         | Europe              | Europe              | Europe              |
| Uplink Frequency (MHz)                   | 5925 – 6425         | 5925 – 6425         | 5925 – 6425         |
| Uplink Beam Polarization                 | Horizontal/Vertical | Horizontal/Vertical | Horizontal/Vertical |
| Uplink Contour G/T (dB/K)                | -1.5                | -1.5                | -1.5                |
| Uplink Contour SFD (dBW/m <sup>2</sup> ) | -90.0               | -90.0               | -90.0               |
| <b>DOWNLINK BEAM INFORMATION</b>         |                     |                     |                     |
| Downlink Beam Name                       | Europe              | Europe              | Europe              |
| Downlink Frequency (MHz)                 | 3700 – 4200         | 3700 – 4200         | 3700 – 4200         |
| Downlink Beam Polarization               | Vertical/Horizontal | Vertical/Horizontal | Vertical/Horizontal |
| Downlink Contour EIRP (dBW)              | 36.1                | 36.1                | 36.1                |
| <b>ADJACENT SATELLITE 1</b>              |                     |                     |                     |
| Satellite 1 Orbital Location             | 40.9 E.L.           | 40.9 E.L.           | 40.9 E.L.           |
| Uplink Power Density (dBW/Hz)            | -38.7               | -38.7               | -38.7               |
| Downlink EIRP Density (dBW/Hz)           | -33.0               | -33.0               | -33.0               |
| <b>ADJACENT SATELLITE 2</b>              |                     |                     |                     |
| Satellite 2 Orbital Location             | 44.9 E.L.           | 44.9 E.L.           | 44.9 E.L.           |
| Uplink Power Density (dBW/Hz)            | -38.7               | -38.7               | -38.7               |
| Downlink EIRP Density (dBW/Hz)           | -38.7               | -38.7               | -38.7               |
| <b>CARRIER INFORMATION</b>               |                     |                     |                     |
| Carrier ID                               | 36M0G7W             | 10M3G7W             | 100KG7W             |
| Information Rate (kbps)                  | 24575               | 6000                | 64                  |
| Carrier Modulation                       | QPSK                | QPSK                | QPSK                |
| Peak to Peak Bandwidth of EDS (MHz)      | n/a                 | n/a                 | n/a                 |
| Code Rate                                | 1/2 - RS            | 1/2 - RS            | 1/2-RS              |
| Occupied Bandwidth (kHz)                 | 30133               | 6771.1              | 75.4                |
| Allocated Bandwidth (kHz)                | 36000               | 10300               | 100                 |
| Required Minimum C/N (dB)                | 3.4                 | 3.9                 | 3.0                 |
| <b>UPLINK EARTH STATION</b>              |                     |                     |                     |
| Earth Station Diameter (meters)          | 6.1                 | 6.1                 | 6.1                 |
| Earth Station Gain (dBi)                 | 49.4                | 49.4                | 49.4                |
| Earth Station Elevation Angle            | 20                  | 20                  | 20                  |
| <b>DOWNLINK EARTH STATION</b>            |                     |                     |                     |
| Earth Station Diameter (meters)          | 3.0                 | 3.0                 | 3.0                 |
| Earth Station Gain (dBi)                 | 39.7                | 39.7                | 39.7                |
| Earth Station G/T (dB/K)                 | 19.2                | 19.2                | 19.2                |
| Earth Station Elevation Angle            | 20                  | 20                  | 20                  |
| <b>UPLINK PERFORMANCE</b>                |                     |                     |                     |
| Uplink Earth Station EIRP (dBW)          | 72.9                | 64.6                | 44.2                |
| Uplink Path Loss, Clear Skv (dB)         | -200.2              | -200.2              | -200.2              |
| Satellite G/T (dB/K)                     | -1.5                | -1.5                | -1.5                |
| Boltzman Constant (dBW/K-Hz)             | 228.6               | 228.6               | 228.6               |
| Carrier Noise Bandwidth (dB-Hz)          | -74.8               | -68.3               | -48.8               |
| Uplink C/N (dB)                          | 25.0                | 23.2                | 22.3                |
| <b>DOWNLINK PERFORMANCE</b>              |                     |                     |                     |
| Downlink EIRP per Carrier (dBW)          | 36.1                | 28.1                | 7.7                 |
| Antenna Pointing Error (dB)              | -0.5                | -0.5                | -0.5                |
| Downlink Path Loss, Clear Sky (dB)       | -196.3              | -196.3              | -196.3              |
| Earth Station G/T (dB/K)                 | 19.2                | 19.2                | 19.2                |
| Boltzman Constant (dBW/K-Hz)             | 228.6               | 228.6               | 228.6               |
| Carrier Noise Bandwidth (dB-Hz)          | -74.8               | -68.3               | -48.8               |
| Downlink C/N (dB)                        | 12.3                | 10.8                | 9.9                 |
| <b>COMPOSITE LINK PERFORMANCE</b>        |                     |                     |                     |
| C/N Uplink (dB)                          | 25.0                | 23.2                | 22.3                |
| C/N Downlink (dB)                        | 12.3                | 10.8                | 9.9                 |
| C/I Intermodulation (dB)                 | n/a                 | 19.5                | 18.6                |
| C/I Uplink Co-Channel (dB)*              | 27.0                | 27.9                | 27.6                |
| C/I Downlink Co-Channel (dB)*            | 27.0                | 27.9                | 27.6                |
| C/I Uplink Adjacent Satellite 1 (dB)     | 14.8                | 13.0                | 12.1                |
| C/I Downlink Adjacent Satellite 1 (dB)   | 11.2                | 9.7                 | 8.8                 |
| C/I Uplink Adjacent Satellite 2 (dB)     | 14.8                | 13.0                | 12.1                |
| C/I Downlink Adjacent Satellite 2 (dB)   | 19.9                | 18.4                | 17.5                |
| C/(N+I) Composite (dB)                   | 6.6                 | 4.9                 | 4.0                 |
| Required System Margin (dB)              | -1.0                | -1.0                | -1.0                |
| Net C/(N+I) Composite (dB)               | 5.6                 | 3.9                 | 3.0                 |
| Minimum Required C/N (dB)                | -3.4                | -3.9                | -3.0                |
| Excess Link Margin (dB)                  | 2.2                 | 0.0                 | 0.0                 |
| <b>CARRIER DENSITY LEVELS</b>            |                     |                     |                     |
| Uplink Power Density (dBW/Hz)            | -51.3               | -53.1               | -54.0               |
| Downlink EIRP Density At Beam Peak       | -34.7               | -36.2               | -37.1               |

## EXHIBIT 5: INTERFERENCE ANALYSIS (continued)

|   |               |               |               |               |
|---|---------------|---------------|---------------|---------------|
| <b>UPLINK BEAM INFORMATION</b>              |               |               |               |               |
| Uplink Beam Name                            | Europe        | Europe        | Europe        | Europe        |
| Uplink Frequency (MHz)                      | 14000 – 14500 | 14000 – 14500 | 14000 – 14500 | 14000 – 14500 |
| Uplink Beam Polarization                    | Horizontal    | Horizontal    | Horizontal    | Horizontal    |
| Uplink Contour G/T (dB/K)                   | 0.3           | 0.3           | 0.3           | 0.3           |
| Uplink Contour SFD (dBW/m <sup>2</sup> )    | -78.8         | -90.8         | -90.8         | -90.8         |
| Rain Rate (mm/hr)                           | 42.0          | 42.0          | 42.0          | 42.0          |
| <b>DOWNLINK BEAM INFORMATION</b>            |               |               |               |               |
| Downlink Beam Name                          | Europe        | Europe        | Europe        | Europe        |
| Downlink Frequency (MHz)                    | 11700 – 12200 | 11700 – 12200 | 11700 – 12200 | 11700 – 12200 |
| Downlink Beam Polarization                  | Vertical      | Vertical      | Vertical      | Vertical      |
| Downlink Contour EIRP (dBW)                 | 45.7          | 45.7          | 45.7          | 45.7          |
| Rain Rate (mm/hr)                           | 42.0          | 42.0          | 42.0          | 42.0          |
| <b>ADJACENT SATELLITE 1</b>                 |               |               |               |               |
| Satellite 1 Orbital Location                | 40.9 E.L.     | 40.9 E.L.     | 40.9 E.L.     | 40.9 E.L.     |
| Uplink Power Density (dBW/Hz)               | -50.0         | -50.0         | -50.0         | -50.0         |
| Downlink EIRP Density (dBW/Hz)              | -26.0         | -26.0         | -26.0         | -26.0         |
| <b>ADJACENT SATELLITE 2</b>                 |               |               |               |               |
| Satellite 2 Orbital Location                | 44.9 E.L.     | 44.9 E.L.     | 44.9 E.L.     | 44.9 E.L.     |
| Uplink Power Density (dBW/Hz)               | -50.0         | -50.0         | -50.0         | -50.0         |
| Downlink EIRP Density (dBW/Hz)              | -26.0         | -26.0         | -26.0         | -26.0         |
| <b>CARRIER INFORMATION</b>                  |               |               |               |               |
| Carrier ID                                  | 36M0G7W       | 10M3G7W       | 100KG7W       | 1M45G7W       |
| Information Rate (kbps)                     | 24575         | 6000          | 64            | 512           |
| Carrier Modulation                          | QPSK          | QPSK          | QPSK          | BPSK          |
| Peak to Peak Bandwidth of EDS (MHz)         | n/a           | n/a           | n/a           | n/a           |
| Code Rate                                   | 1/2 - RS      | 1/2 - RS      | 1/2-RS        | 1/2           |
| Occupied Bandwidth (kHz)                    | 30133         | 6771.1        | 75.4          | 1229          |
| Assumed Allocated Bandwidth (kHz)           | 36000         | 10300         | 100           | 1450          |
| Required Minimum C/N (dB) – Clear Sky       | 3.4           | 3.9           | 3.0           | 3.4           |
| Required Minimum C/N (dB) – Rain            | 3.4           | 3.5           | 2.8           | 2.7           |
| <b>UPLINK EARTH STATION</b>                 |               |               |               |               |
| Earth Station Diameter (meters)             | 6.1           | 6.1           | 6.1           | 6.1           |
| Earth Station Gain (dBi)                    | 56.9          | 56.9          | 56.9          | 56.9          |
| Earth Station Elevation Angle               | 20            | 20            | 20            | 20            |
| <b>DOWNLINK EARTH STATION</b>               |               |               |               |               |
| Earth Station Diameter (meters)             | 1.2           | 1.8           | 1.8           | 1.8           |
| Earth Station Gain (dBi)                    | 41.3          | 44.8          | 44.8          | 44.8          |
| Earth Station G/T (dB/K)                    | 18.8          | 22.3          | 22.3          | 22.3          |
| Earth Station Elevation Angle               | 20            | 20            | 20            | 20            |
| LINK FADE TYPE                              | Clear Sky     | Clear Sky     | Clear Sky     | Clear Sky     |
| <b>UPLINK PERFORMANCE</b>                   |               |               |               |               |
| Uplink Earth Station EIRP (dBW)             | 80.3          | 59.9          | 39.7          | 51.7          |
| Uplink Path Loss, Clear Sky (dB)            | -207.5        | -207.5        | -207.5        | -207.5        |
| Satellite G/T (dB/K)                        | 0.3           | 0.3           | 0.3           | 0.3           |
| Boltzman Constant (dBW/K-Hz)                | 228.6         | 228.6         | 228.6         | 228.6         |
| Carrier Noise Bandwidth (dB-Hz)             | -74.8         | -68.3         | -48.8         | -60.9         |
| Uplink C/N (dB)                             | 26.9          | 13.0          | 12.4          | 12.3          |
| <b>DOWNLINK PERFORMANCE</b>                 |               |               |               |               |
| Downlink EIRP per Carrier (dBW)             | 44.8          | 36.9          | 16.7          | 28.7          |
| Antenna Pointing Error (dB)                 | -0.5          | -0.5          | -0.5          | -0.5          |
| Downlink Path Loss, Clear Sky (dB)          | -205.9        | -205.9        | -205.9        | -205.9        |
| Earth Station G/T (dB/K)                    | 18.8          | 22.3          | 22.3          | 22.3          |
| Boltzman Constant (dBW/K-Hz)                | 228.6         | 228.6         | 228.6         | 228.6         |
| Carrier Noise Bandwidth (dB-Hz)             | -74.8         | -68.3         | -48.8         | -60.9         |
| Downlink C/N (dB)                           | 10.9          | 13.0          | 12.4          | 12.3          |
| <b>COMPOSITE LINK PERFORMANCE</b>           |               |               |               |               |
| C/N Uplink (dB)                             | 26.9          | 13.0          | 12.4          | 12.3          |
| C/N Downlink (dB)                           | 10.9          | 13.0          | 12.4          | 12.3          |
| C/I Intermodulation (dB)                    | n/a           | 17.2          | 16.6          | 16.5          |
| C/I Uplink Co-Channel (dB)*                 | 27.0          | 28.2          | 28.2          | 28.6          |
| C/I Downlink Co-Channel (dB)*               | 27.0          | 28.2          | 28.2          | 28.6          |
| C/I Uplink Adjacent Satellite 1 (dB)        | 31.5          | 17.6          | 17.0          | 16.8          |
| C/I Downlink Adjacent Satellite 1 (dB)      | 13.8          | 16.8          | 16.1          | 16.0          |
| C/I Uplink Adjacent Satellite 2 (dB)        | 31.5          | 17.6          | 17.0          | 16.8          |
| C/I Downlink Adjacent Satellite 2 (dB)      | 17.2          | 18.9          | 18.2          | 18.1          |
| C/(N+I) Composite (dB)                      | 8.3           | 7.2           | 6.6           | 6.5           |
| Required System Margin (dB)                 | -1.0          | -1.0          | -1.0          | -1.0          |
| Net C/(N+I) Composite (dB)                  | 7.3           | 6.2           | 5.6           | 5.5           |
| Minimum Required C/N (dB)                   | -3.4          | -3.9          | 3.0           | -3.4          |
| Excess Link Margin (dB)                     | 3.9           | 2.3           | 2.6           | 2.1           |
| <b>Carrier Density Levels</b>               |               |               |               |               |
| Uplink Power Density (dBW/Hz)               | -51.4         | -65.3         | -65.9         | -66.1         |
| Downlink EIRP Density At Beam Peak (dBW/Hz) | -26.0         | -27.4         | -28.1         | -28.2         |

## EXHIBIT 5: INTERFERENCE ANALYSIS (continued)

|   |               |               |               |               |
|---|---------------|---------------|---------------|---------------|
| <b>UPLINK BEAM INFORMATION</b>              |               |               |               |               |
| Uplink Beam Name                            | Europe        | Europe        | Europe        | Europe        |
| Uplink Frequency (MHz)                      | 14000 – 14500 | 14000 – 14500 | 14000 – 14500 | 14000 – 14500 |
| Uplink Beam Polarization                    | Vertical      | Vertical      | Vertical      | Vertical      |
| Uplink Contour G/T (dB/K)                   | -1.2          | -1.2          | -1.2          | -1.2          |
| Uplink Contour SFD (dBW/m <sup>2</sup> )    | -78.3         | -90.3         | -90.3         | -90.3         |
| Rain Rate (mm/hr)                           | 42.0          | 42.0          | 42.0          | 42.0          |
| <b>DOWNLINK BEAM INFORMATION</b>            |               |               |               |               |
| Downlink Beam Name                          | Europe        | Europe        | Europe        | Europe        |
| Downlink Frequency (MHz)                    | 11700 – 12200 | 11700 – 12200 | 11700 – 12200 | 11700 – 12200 |
| Downlink Beam Polarization                  | Horizontal    | Horizontal    | Horizontal    | Horizontal    |
| Downlink Contour EIRP (dBW)                 | 45.7          | 45.7          | 45.7          | 45.7          |
| Rain Rate (mm/hr)                           | 42.0          | 42.0          | 42.0          | 42.0          |
| <b>ADJACENT SATELLITE 1</b>                 |               |               |               |               |
| Satellite 1 Orbital Location                | 40.9 E.L.     | 40.9 E.L.     | 40.9 E.L.     | 40.9 E.L.     |
| Uplink Power Density (dBW/Hz)               | -50.0         | -50.0         | -50.0         | -50.0         |
| Downlink EIRP Density (dBW/Hz)              | -26.0         | -26.0         | -26.0         | -26.0         |
| <b>ADJACENT SATELLITE 2</b>                 |               |               |               |               |
| Satellite 2 Orbital Location                | 44.9 E.L.     | 44.9 E.L.     | 44.9 E.L.     | 44.9 E.L.     |
| Uplink Power Density (dBW/Hz)               | -50.0         | -50.0         | -50.0         | -50.0         |
| Downlink EIRP Density (dBW/Hz)              | -26.0         | -26.0         | -26.0         | -26.0         |
| <b>CARRIER INFORMATION</b>                  |               |               |               |               |
| Carrier ID                                  | 36M0G7W       | 10M3G7W       | 100KG7W       | 1M45G7W       |
| Information Rate (kbps)                     | 24575         | 6000          | 64            | 512           |
| Carrier Modulation                          | QPSK          | QPSK          | QPSK          | BPSK          |
| Peak to Peak Bandwidth of EDS (MHz)         | n/a           | n/a           | n/a           | n/a           |
| Code Rate                                   | 1/2 - RS      | 1/2 - RS      | 1/2-RS        | 1/2           |
| Occupied Bandwidth (kHz)                    | 30133         | 6771.1        | 75.4          | 1229          |
| Assumed Allocated Bandwidth (kHz)           | 36000         | 10300         | 100           | 1450          |
| Required Minimum C/N (dB) – Clear Sky       | 3.4           | 3.9           | 3.0           | 3.4           |
| Required Minimum C/N (dB) – Rain            | 3.4           | 3.5           | 2.8           | 2.7           |
| <b>UPLINK EARTH STATION</b>                 |               |               |               |               |
| Earth Station Diameter (meters)             | 6.1           | 6.1           | 6.1           | 6.1           |
| Earth Station Gain (dBi)                    | 56.9          | 56.9          | 56.9          | 56.9          |
| Earth Station Elevation Angle               | 20            | 20            | 20            | 20            |
| <b>DOWNLINK EARTH STATION</b>               |               |               |               |               |
| Earth Station Diameter (meters)             | 1.2           | 1.8           | 1.8           | 1.8           |
| Earth Station Gain (dBi)                    | 41.3          | 44.8          | 44.8          | 44.8          |
| Earth Station G/T (dB/K)                    | 18.8          | 22.3          | 22.3          | 22.3          |
| Earth Station Elevation Angle               | 20            | 20            | 20            | 20            |
| LINK FADE TYPE                              | Clear Sky     | Clear Sky     | Clear Sky     | Clear Sky     |
| <b>UPLINK PERFORMANCE</b>                   |               |               |               |               |
| Uplink Earth Station EIRP (dBW)             | 80.9          | 60.5          | 40.3          | 52.3          |
| Uplink Path Loss, Clear Sky (dB)            | -207.5        | -207.5        | -207.5        | -207.5        |
| Satellite G/T (dB/K)                        | -1.2          | -1.2          | -1.2          | -1.2          |
| Boltzman Constant (dBW/K-Hz)                | 228.6         | 228.6         | 228.6         | 228.6         |
| Carrier Noise Bandwidth (dB-Hz)             | -74.8         | -68.3         | -48.8         | -60.9         |
| Uplink C/N (dB)                             | 26.0          | 12.1          | 11.4          | 11.3          |
| <b>DOWNLINK PERFORMANCE</b>                 |               |               |               |               |
| Downlink EIRP per Carrier (dBW)             | 44.8          | 36.9          | 16.8          | 28.8          |
| Antenna Pointing Error (dB)                 | -0.5          | -0.5          | -0.5          | -0.5          |
| Downlink Path Loss, Clear Sky (dB)          | -205.9        | -205.9        | -205.9        | -205.9        |
| Earth Station G/T (dB/K)                    | 18.8          | 22.3          | 22.3          | 22.3          |
| Boltzman Constant (dBW/K-Hz)                | 228.6         | 228.6         | 228.6         | 228.6         |
| Carrier Noise Bandwidth (dB-Hz)             | -74.8         | -68.3         | -48.8         | -60.9         |
| Downlink C/N (dB)                           | 11.0          | 13.1          | 12.4          | 12.3          |
| <b>COMPOSITE LINK PERFORMANCE</b>           |               |               |               |               |
| C/N Uplink (dB)                             | 26.0          | 12.1          | 11.4          | 11.3          |
| C/N Downlink (dB)                           | 11.0          | 13.1          | 12.4          | 12.3          |
| C/I Intermodulation (dB)                    | n/a           | 17.3          | 16.6          | 16.5          |
| C/I Uplink Co-Channel (dB)*                 | 27.0          | 28.3          | 28.2          | 28.6          |
| C/I Downlink Co-Channel (dB)*               | 27.0          | 28.3          | 28.2          | 28.6          |
| C/I Uplink Adjacent Satellite 1 (dB)        | 32.1          | 18.1          | 17.5          | 17.4          |
| C/I Downlink Adjacent Satellite 1 (dB)      | 13.9          | 16.8          | 16.2          | 16.1          |
| C/I Uplink Adjacent Satellite 2 (dB)        | 32.1          | 18.1          | 17.5          | 17.4          |
| C/I Downlink Adjacent Satellite 2 (dB)      | 17.3          | 18.9          | 18.3          | 18.2          |
| C/(N+I) Composite (dB)                      | 8.3           | 7.0           | 6.4           | 6.3           |
| Required System Margin (dB)                 | -1.0          | -1.0          | -1.0          | -1.0          |
| Net C/(N+I) Composite (dB)                  | 7.3           | 6.0           | 5.4           | 5.3           |
| Minimum Required C/N (dB)                   | -3.4          | -3.9          | 3.0           | -3.4          |
| Excess Link Margin (dB)                     | 3.9           | 2.1           | 2.4           | 1.9           |
| <b>Carrier Density Levels</b>               |               |               |               |               |
| Uplink Power Density (dBW/Hz)               | -50.8         | -64.8         | -65.4         | -65.5         |
| Downlink EIRP Density At Beam Peak (dBW/Hz) | -26.0         | -27.4         | -28.0         | -28.1         |

## EXHIBIT 5: INTERFERENCE ANALYSIS (continued)

| <b>UPLINK BEAM INFORMATION</b>              |                    |                    |                    |                    |
|---|--------------------|--------------------|--------------------|--------------------|
| Uplink Beam Name                            | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe |
| Uplink Frequency (MHz)                      | 13.75 – 14.00      | 13.75 – 14.00      | 13.75 – 14.00      | 13.75 – 14.00      |
| Uplink Beam Polarization                    | Horizontal         | Horizontal         | Horizontal         | Horizontal         |
| Uplink Contour G/T (dB/K)                   | -2.8               | -2.8               | -2.8               | -2.8               |
| Uplink SFD (dBW/m <sup>2</sup> )            | -73.3              | -85.3              | -85.3              | -85.3              |
| Rain Rate (mm/hr)                           | 42.0               | 42.0               | 42.0               | 42.0               |
| <b>DOWNLINK BEAM INFORMATION</b>            |                    |                    |                    |                    |
| Downlink Beam Name                          | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe |
| Downlink Frequency (MHz)                    | 10.95–11.20        | 10.95–11.20        | 10.95–11.20        | 10.95–11.20        |
| Downlink Beam Polarization                  | Vertical           | Vertical           | Vertical           | Vertical           |
| Downlink Contour EIRP (dBW)                 | 46.0               | 46.0               | 46.0               | 46.0               |
| Rain Rate (mm/hr)                           | 42.0               | 42.0               | 42.0               | 42.0               |
| <b>ADJACENT SATELLITE 1</b>                 |                    |                    |                    |                    |
| Satellite 1 Orbital Location                | 40.9 E.L.          | 40.9 E.L.          | 40.9 E.L.          | 40.9 E.L.          |
| Uplink Power Density (dBW/Hz)               | -50.0              | -50.0              | -50.0              | -50.0              |
| Downlink EIRP Density (dBW/Hz)              | -26.0              | -26.0              | -26.0              | -26.0              |
| <b>ADJACENT SATELLITE 2</b>                 |                    |                    |                    |                    |
| Satellite 1 Orbital Location                | 44.9 E.L.          | 44.9 E.L.          | 44.9 E.L.          | 44.9 E.L.          |
| Uplink Power Density (dBW/Hz)               | -50.0              | -50.0              | -50.0              | -50.0              |
| Downlink EIRP Density (dBW/Hz)              | -26.0              | -26.0              | -26.0              | -26.0              |
| <b>CARRIER INFORMATION</b>                  |                    |                    |                    |                    |
| Carrier ID                                  | 27M0G7W            | 10M3G7W            | 100KG7W            | 1M45G7W            |
| Carrier Modulation                          | QPSK               | QPSK               | QPSK               | BPSK               |
| Peak to Peak Bandwidth of EDS (MHz)         | N/A                | N/A                | N/A                | N/A                |
| Information Rate(kbps)                      | 18432              | 6000               | 64                 | 512                |
| Code Rate                                   | 1/2x188/204        | 1/2x188/204        | 1/2x239/256        | R1/2               |
| Occupied Bandwidth(kHz)                     | 22600              | 6771.1             | 75.4               | 1229.0             |
| Allocated Bandwidth(kHz)                    | 27000              | 10300              | 100                | 1450.0             |
| Minimum C/N, Clear Sky (dB)                 | 3.4                | 3.9                | 3.0                | 3.4                |
| Minimum C/N, Rain (dB)                      | 3.4                | 3.6                | 2.8                | 2.7                |
| <b>UPLINK EARTH STATION</b>                 |                    |                    |                    |                    |
| Earth Station Diameter (meters)             | 6.1                | 6.1                | 6.1                | 6.1                |
| Earth Station Gain (dBi)                    | 56.7               | 56.7               | 56.7               | 56.7               |
| Earth Station Elevation Angle               | 20                 | 20                 | 20                 | 20                 |
| <b>DOWNLINK EARTH STATION</b>               |                    |                    |                    |                    |
| Earth Station Diameter (meters)             | 1.8                | 1.8                | 1.8                | 1.8                |
| Earth Station Gain (dBi)                    | 44.1               | 44.1               | 44.1               | 44.1               |
| Earth Station G/T (dB/K)                    | 21.6               | 21.6               | 21.6               | 21.6               |
| Earth Station Elevation Angle               | 20                 | 20                 | 20                 | 20                 |
| <b>LINK FADE TYPE</b>                       |                    |                    |                    |                    |
|   | Clear Sky          | Clear Sky          | Clear Sky          | Clear Sky          |
| <b>UPLINK PERFORMANCE</b>                   |                    |                    |                    |                    |
| Uplink Earth Station EIRP (dBW)             | 79.6               | 64.4               | 44.2               | 56.2               |
| Uplink Path Loss, Clear Sky (dB)            | -207.2             | -207.2             | -207.2             | -207.2             |
| Uplink Rain Attenuation                     | 0.0                | 0.0                | 0.0                | 0.0                |
| Satellite G/T(dB/K)                         | -2.8               | -2.8               | -2.8               | -2.8               |
| Boltzman Constant(dBW/K -Hz)                | 228.6              | 228.6              | 228.6              | 228.6              |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5              | -68.3              | -48.8              | -60.9              |
| Uplink C/N(dB)                              | 24.6               | 14.7               | 14.0               | 13.9               |
| <b>DOWNLINK PERFORMANCE</b>                 |                    |                    |                    |                    |
| Downlink EIRP per Carrier (dBW)             | 41.4               | 36.2               | 16.0               | 28.0               |
| Antenna Pointing Error (dB)                 | -.5                | -.5                | -.5                | -.5                |
| Downlink Path Loss, Clear Sky (dB)          | -205.3             | -205.3             | -205.3             | -205.3             |
| Downlink Rain Attenuation                   | 0.0                | 0.0                | 0.0                | 0.0                |
| Earth Station G/T (dB/K)                    | 21.6               | 21.6               | 21.6               | 21.6               |
| Boltzman Constant(dBW / K - Hz)             | 228.6              | 228.6              | 228.6              | 228.6              |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5              | -68.3              | -48.8              | -60.9              |
| Downlink C / N(dB)                          | 12.3               | 12.3               | 11.7               | 11.6               |
| <b>COMPOSITE LINK PERFORMANCE</b>           |                    |                    |                    |                    |
| C/N Uplink (dB)                             | 24.6               | 14.7               | 14.0               | 13.9               |
| C/N Downlink (dB)                           | 12.3               | 12.3               | 11.7               | 11.6               |
| C/I Intermodulation (dB)                    | N/A                | 15.0               | 14.3               | 14.2               |
| C/I Uplink Co-Channel (dB)*                 | 24.0               | 23.0               | 23.0               | 23.3               |
| C/I Downlink Co-Channel (dB)*               | 24.0               | 23.0               | 23.0               | 23.3               |
| C/I Uplink Adjacent Satellite 1 (dB)        | 30.1               | 20.1               | 19.5               | 19.3               |
| C/I Downlink Adjacent Satellite 1 (dB)      | 15.3               | 15.4               | 14.7               | 14.6               |
| C/I Uplink Adjacent Satellite 2 (dB)        | 30.1               | 20.1               | 19.5               | 19.3               |
| C/I Downlink Adjacent Satellite 2 (dB)      | 17.5               | 17.6               | 16.9               | 16.8               |
| C/(N+I) Composite (dB)                      | 9.2                | 7.0                | 6.4                | 6.3                |
| Required System Margin (dB)                 | -1.0               | -1.0               | -1.0               | -1.0               |
| Net C/(N+I) Composite (dB)                  | 8.2                | 6.0                | 5.4                | 5.3                |
| Minimum Required C/N (dB)                   | -3.4               | -3.9               | -3.0               | -3.4               |
| Excess Link Margin (dB)                     | 4.9                | 2.1                | 2.4                | 1.9                |
| <b>CARRIER DENSITY LEVELS</b>               |                    |                    |                    |                    |
| Uplink Power Density (dBW/Hz)               | -50.6              | -60.6              | -61.2              | -61.3              |
| Downlink EIRP Density At Beam Peak (dBW/Hz) | -26.1              | -26.1              | -26.7              | -26.9              |



## EXHIBIT 4: INTERFERENCE ANALYSIS (continued)

| <b>UPLINK BEAM INFORMATION</b>              |                    |                    |                    |                    |
|---|--------------------|--------------------|--------------------|--------------------|
| Uplink Beam Name                            | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe |
| Uplink Frequency (MHz)                      | 13.75 – 14.00      | 13.75 – 14.00      | 13.75 – 14.00      | 13.75 – 14.00      |
| Uplink Beam Polarization                    | Vertical           | Vertical           | Vertical           | Vertical           |
| Uplink Contour G/T (dB/K)                   | -2.8               | -2.8               | -2.8               | -2.8               |
| Uplink SFD (dBW/m2)                         | -73.2              | -85.2              | -85.2              | -85.2              |
| Rain Rate (mm/hr)                           | 42.0               | 42.0               | 42.0               | 42.0               |
| <b>DOWNLINK BEAM INFORMATION</b>            |                    |                    |                    |                    |
| Downlink Beam Name                          | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe |
| Downlink Frequency (MHz)                    | 10.95–11.20        | 10.95–11.20        | 10.95–11.20        | 10.95–11.20        |
| Downlink Beam Polarization                  | Horizontal         | Horizontal         | Horizontal         | Horizontal         |
| Downlink Contour EIRP (dBW)                 | 46.1               | 46.1               | 46.1               | 46.1               |
| Rain Rate (mm/hr)                           | 42.0               | 42.0               | 42.0               | 42.0               |
| <b>ADJACENT SATELLITE 1</b>                 |                    |                    |                    |                    |
| Satellite 1 Orbital Location                | 40.9 E.L.          | 40.9 E.L.          | 40.9 E.L.          | 40.9 E.L.          |
| Uplink Power Density (dBW/Hz)               | -50.0              | -50.0              | -50.0              | -50.0              |
| Downlink EIRP Density (dBW/Hz)              | -26.0              | -26.0              | -26.0              | -26.0              |
| <b>ADJACENT SATELLITE 2</b>                 |                    |                    |                    |                    |
| Satellite 1 Orbital Location                | 44.9 E.L.          | 44.9 E.L.          | 44.9 E.L.          | 44.9 E.L.          |
| Uplink Power Density (dBW/Hz)               | -50.0              | -50.0              | -50.0              | -50.0              |
| Downlink EIRP Density (dBW/Hz)              | -26.0              | -26.0              | -26.0              | -26.0              |
| <b>CARRIER INFORMATION</b>                  |                    |                    |                    |                    |
| Carrier ID                                  | 27M0G7W            | 10M3G7W            | 100KG7W            | 1M45G7W            |
| Carrier Modulation                          | QPSK               | QPSK               | QPSK               | BPSK               |
| Peak to Peak Bandwidth of EDS (MHz)         | N/A                | N/A                | N/A                | N/A                |
| Information Rate(kbps)                      | 18432              | 6000               | 64                 | 512                |
| Code Rate                                   | 1/2x188/204        | 1/2x188/204        | 1/2x239/256        | R1/2               |
| Occupied Bandwidth(kHz)                     | 22600              | 6771.1             | 75.4               | 1229.0             |
| Allocated Bandwidth(kHz)                    | 27000              | 10300              | 100                | 1450.0             |
| Minimum C/N, Clear Sky (dB)                 | 3.4                | 3.9                | 3.0                | 3.4                |
| Minimum C/N, Rain (dB)                      | 3.4                | 3.6                | 2.8                | 2.7                |
| <b>UPLINK EARTH STATION</b>                 |                    |                    |                    |                    |
| Earth Station Diameter (meters)             | 6.1                | 6.1                | 6.1                | 6.1                |
| Earth Station Gain (dBi)                    | 56.7               | 56.7               | 56.7               | 56.7               |
| Earth Station Elevation Angle               | 20                 | 20                 | 20                 | 20                 |
| <b>DOWNLINK EARTH STATION</b>               |                    |                    |                    |                    |
| Earth Station Diameter (meters)             | 1.8                | 1.8                | 1.8                | 1.8                |
| Earth Station Gain (dBi)                    | 44.1               | 44.1               | 44.1               | 44.1               |
| Earth Station G/T (dB/K)                    | 21.6               | 21.6               | 21.6               | 21.6               |
| Earth Station Elevation Angle               | 20                 | 20                 | 20                 | 20                 |
| <b>LINK FADE TYPE</b>                       |                    |                    |                    |                    |
|   | Clear Sky          | Clear Sky          | Clear Sky          | Clear Sky          |
| <b>UPLINK PERFORMANCE</b>                   |                    |                    |                    |                    |
| Uplink Earth Station EIRP (dBW)             | 79.7               | 64.3               | 44.1               | 56.1               |
| Uplink Path Loss, Clear Sky (dB)            | -207.2             | -207.2             | -207.2             | -207.2             |
| Uplink Rain Attenuation                     | 0.0                | 0.0                | 0.0                | 0.0                |
| Satellite G/T(dB/K)                         | -2.8               | -2.8               | -2.8               | -2.8               |
| Boltzman Constant(dBW/K -Hz)                | 228.6              | 228.6              | 228.6              | 228.6              |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5              | -68.3              | -48.8              | -60.9              |
| Uplink C/N(dB)                              | 24.7               | 14.6               | 13.9               | 13.8               |
| <b>DOWNLINK PERFORMANCE</b>                 |                    |                    |                    |                    |
| Downlink EIRP per Carrier (dBW)             | 41.5               | 36.1               | 15.9               | 27.9               |
| Antenna Pointing Error (dB)                 | -.5                | -.5                | -.5                | -.5                |
| Downlink Path Loss, Clear Sky (dB)          | -205.3             | -205.3             | -205.3             | -205.3             |
| Downlink Rain Attenuation                   | 0.0                | 0.0                | 0.0                | 0.0                |
| Earth Station G/T (dB/K)                    | 21.6               | 21.6               | 21.6               | 21.6               |
| Boltzman Constant(dBW / K - Hz)             | 228.6              | 228.6              | 228.6              | 228.6              |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5              | -68.3              | -48.8              | -60.9              |
| Downlink C / N(dB)                          | 12.4               | 12.2               | 11.6               | 11.4               |
| <b>COMPOSITE LINK PERFORMANCE</b>           |                    |                    |                    |                    |
| C/N Uplink (dB)                             | 24.7               | 14.6               | 13.9               | 13.8               |
| C/N Downlink (dB)                           | 12.4               | 12.2               | 11.6               | 11.4               |
| C/I Intermodulation (dB)                    | N/A                | 14.8               | 14.1               | 14.0               |
| C/I Uplink Co-Channel (dB)*                 | 24.0               | 22.8               | 22.7               | 23.1               |
| C/I Downlink Co-Channel (dB)*               | 24.0               | 22.8               | 22.7               | 23.1               |
| C/I Uplink Adjacent Satellite 1 (dB)        | 30.2               | 20.0               | 19.4               | 19.2               |
| C/I Downlink Adjacent Satellite 1 (dB)      | 15.4               | 15.3               | 14.6               | 14.5               |
| C/I Uplink Adjacent Satellite 2 (dB)        | 30.2               | 20.0               | 19.4               | 19.2               |
| C/I Downlink Adjacent Satellite 2 (dB)      | 17.6               | 17.5               | 16.8               | 16.7               |
| C/(N+I) Composite (dB)                      | 9.3                | 6.9                | 6.2                | 6.1                |
| Required System Margin (dB)                 | -1.0               | -1.0               | -1.0               | -1.0               |
| Net C/(N+I) Composite (dB)                  | 8.3                | 5.9                | 5.2                | 5.1                |
| Minimum Required C/N (dB)                   | -3.4               | -3.9               | -3.0               | -3.4               |
| Excess Link Margin (dB)                     | 5.0                | 2.0                | 2.2                | 1.7                |
| <b>CARRIER DENSITY LEVELS</b>               |                    |                    |                    |                    |
| Uplink Power Density (dBW/Hz)               | -50.5              | -60.7              | -61.3              | -61.4              |
| Downlink EIRP Density At Beam Peak (dBW/Hz) | -26.0              | -26.2              | -26.9              | -27.0              |

## EXHIBIT 4: INTERFERENCE ANALYSIS (continued)

| <b>UPLINK BEAM INFORMATION</b>              |                    |                    |                    |                    |
|---|--------------------|--------------------|--------------------|--------------------|
| Uplink Beam Name                            | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe |
| Uplink Frequency (MHz)                      | 13.75 – 14.00      | 13.75 – 14.00      | 13.75 – 14.00      | 13.75 – 14.00      |
| Uplink Beam Polarization                    | Horizontal         | Horizontal         | Horizontal         | Horizontal         |
| Uplink Contour G/T (dB/K)                   | -2.8               | -2.8               | -2.8               | -2.8               |
| Uplink SFD (dBW/m <sup>2</sup> )            | -73.3              | -83.3              | -83.3              | -83.3              |
| Rain Rate (mm/hr)                           | 42.0               | 42.0               | 42.0               | 42.0               |
| <b>DOWNLINK BEAM INFORMATION</b>            |                    |                    |                    |                    |
| Downlink Beam Name                          | Africa             | Africa             | Africa             | Africa             |
| Downlink Frequency (MHz)                    | 10.95–11.20        | 10.95–11.20        | 10.95–11.20        | 10.95–11.20        |
| Downlink Beam Polarization                  | Vertical           | Vertical           | Vertical           | Vertical           |
| Downlink Contour EIRP (dBW)                 | 45.9               | 45.9               | 45.9               | 45.9               |
| Rain Rate (mm/hr)                           | 95.0               | 95.0               | 95.0               | 95.0               |
| <b>ADJACENT SATELLITE 1</b>                 |                    |                    |                    |                    |
| Satellite 1 Orbital Location                | 40.9 E.L.          | 40.9 E.L.          | 40.9 E.L.          | 40.9 E.L.          |
| Uplink Power Density (dBW/Hz)               | -50.0              | -50.0              | -50.0              | -50.0              |
| Downlink EIRP Density (dBW/Hz)              | -26.0              | -26.0              | -26.0              | -26.0              |
| <b>ADJACENT SATELLITE 2</b>                 |                    |                    |                    |                    |
| Satellite 1 Orbital Location                | 44.9 E.L.          | 44.9 E.L.          | 44.9 E.L.          | 44.9 E.L.          |
| Uplink Power Density (dBW/Hz)               | -50.0              | -50.0              | -50.0              | -50.0              |
| Downlink EIRP Density (dBW/Hz)              | -26.0              | -26.0              | -26.0              | -26.0              |
| <b>CARRIER INFORMATION</b>                  |                    |                    |                    |                    |
| Carrier ID                                  | 27M0G7W            | 10M3G7W            | 100KG7W            | 1M45G7W            |
| Carrier Modulation                          | QPSK               | QPSK               | QPSK               | BPSK               |
| Peak to Peak Bandwidth of EDS (MHz)         | N/A                | N/A                | N/A                | N/A                |
| Information Rate(kbps)                      | 18432              | 6000               | 64                 | 512                |
| Code Rate                                   | 1/2x188/204        | 1/2x188/204        | 1/2x239/256        | R1/2               |
| Occupied Bandwidth(kHz)                     | 22600              | 6771.1             | 75.4               | 1229.0             |
| Allocated Bandwidth(kHz)                    | 27000              | 10300              | 100                | 1450.0             |
| Minimum C/N, Clear Sky (dB)                 | 3.4                | 3.9                | 3.0                | 3.4                |
| Minimum C/N, Rain (dB)                      | 3.4                | 3.6                | 2.8                | 2.7                |
| <b>UPLINK EARTH STATION</b>                 |                    |                    |                    |                    |
| Earth Station Diameter (meters)             | 6.1                | 6.1                | 6.1                | 6.1                |
| Earth Station Gain (dBi)                    | 56.7               | 56.7               | 56.7               | 56.7               |
| Earth Station Elevation Angle               | 20                 | 20                 | 20                 | 20                 |
| <b>DOWNLINK EARTH STATION</b>               |                    |                    |                    |                    |
| Earth Station Diameter (meters)             | 1.8                | 1.8                | 1.8                | 1.8                |
| Earth Station Gain (dBi)                    | 44.1               | 44.1               | 44.1               | 44.1               |
| Earth Station G/T (dB/K)                    | 21.6               | 21.6               | 21.6               | 21.6               |
| Earth Station Elevation Angle               | 20                 | 20                 | 20                 | 20                 |
| <b>LINK FADE TYPE</b>                       |                    |                    |                    |                    |
|   | Clear Sky          | Clear Sky          | Clear Sky          | Clear Sky          |
| <b>UPLINK PERFORMANCE</b>                   |                    |                    |                    |                    |
| Uplink Earth Station EIRP (dBW)             | 79.8               | 66.6               | 46.4               | 58.4               |
| Uplink Path Loss, Clear Sky (dB)            | -207.2             | -207.2             | -207.2             | -207.2             |
| Uplink Rain Attenuation                     | 0.0                | 0.0                | 0.0                | 0.0                |
| Satellite G/T(dB/K)                         | -2.8               | -2.8               | -2.8               | -2.8               |
| Boltzman Constant(dBW/K -Hz)                | 228.6              | 228.6              | 228.6              | 228.6              |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5              | -68.3              | -48.8              | -60.9              |
| Uplink C/N(dB)                              | 24.8               | 16.9               | 16.2               | 16.1               |
| <b>DOWNLINK PERFORMANCE</b>                 |                    |                    |                    |                    |
| Downlink EIRP per Carrier (dBW)             | 41.5               | 36.3               | 16.1               | 28.1               |
| Antenna Pointing Error (dB)                 | -.5                | -.5                | -.5                | -.5                |
| Downlink Path Loss, Clear Sky (dB)          | -205.2             | -205.2             | -205.2             | -205.2             |
| Downlink Rain Attenuation                   | 0.0                | 0.0                | 0.0                | 0.0                |
| Earth Station G/T (dB/K)                    | 21.6               | 21.6               | 21.6               | 21.6               |
| Boltzman Constant(dBW / K - Hz)             | 228.6              | 228.6              | 228.6              | 228.6              |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5              | -68.3              | -48.8              | -60.9              |
| Downlink C / N(dB)                          | 12.4               | 12.4               | 11.8               | 11.7               |
| <b>COMPOSITE LINK PERFORMANCE</b>           |                    |                    |                    |                    |
| C/N Uplink (dB)                             | 24.8               | 16.9               | 16.2               | 16.1               |
| C/N Downlink (dB)                           | 12.4               | 12.4               | 11.8               | 11.7               |
| C/I Intermodulation (dB)                    | N/A                | 15.2               | 14.5               | 14.4               |
| C/I Uplink Co-Channel (dB)*                 | 24.0               | 23.2               | 23.2               | 23.5               |
| C/I Downlink Co-Channel (dB)*               | 24.0               | 23.2               | 23.2               | 23.5               |
| C/I Uplink Adjacent Satellite 1 (dB)        | 30.3               | 22.3               | 21.7               | 21.5               |
| C/I Downlink Adjacent Satellite 1 (dB)      | 15.4               | 15.5               | 14.8               | 14.7               |
| C/I Uplink Adjacent Satellite 2 (dB)        | 30.3               | 22.3               | 21.7               | 21.5               |
| C/I Downlink Adjacent Satellite 2 (dB)      | 17.6               | 17.6               | 17.0               | 16.9               |
| C/(N+I) Composite (dB)                      | 9.3                | 7.6                | 6.9                | 6.8                |
| Required System Margin (dB)                 | -1.0               | -1.0               | -1.0               | -1.0               |
| Net C/(N+I) Composite (dB)                  | 8.3                | 6.6                | 5.9                | 5.8                |
| Minimum Required C/N (dB)                   | -3.4               | -3.9               | -3.0               | -3.4               |
| Excess Link Margin (dB)                     | 4.9                | 2.7                | 3.0                | 2.4                |
| <b>CARRIER DENSITY LEVELS</b>               |                    |                    |                    |                    |
| Uplink Power Density (dBW/Hz)               | -50.4              | -58.4              | -59.0              | -59.1              |
| Downlink EIRP Density At Beam Peak (dBW/Hz) | -26.1              | -26.0              | -26.7              | -26.8              |

## EXHIBIT 4: INTERFERENCE ANALYSIS (continued)

| <b>UPLINK BEAM INFORMATION</b>              |                    |                    |                    |                    |
|---|--------------------|--------------------|--------------------|--------------------|
| Uplink Beam Name                            | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe |
| Uplink Frequency (MHz)                      | 13.75 – 14.00      | 13.75 – 14.00      | 13.75 – 14.00      | 13.75 – 14.00      |
| Uplink Beam Polarization                    | Vertical           | Vertical           | Vertical           | Vertical           |
| Uplink Contour G/T (dB/K)                   | -2.8               | -2.8               | -2.8               | -2.8               |
| Uplink SFD (dBW/m <sup>2</sup> )            | -73.2              | -82.2              | -82.2              | -82.2              |
| Rain Rate (mm/hr)                           | 42.0               | 42.0               | 42.0               | 42.0               |
| <b>DOWNLINK BEAM INFORMATION</b>            |                    |                    |                    |                    |
| Downlink Beam Name                          | Africa             | Africa             | Africa             | Africa             |
| Downlink Frequency (MHz)                    | 10.95–11.20        | 10.95–11.20        | 10.95–11.20        | 10.95–11.20        |
| Downlink Beam Polarization                  | Horizontal         | Horizontal         | Horizontal         | Horizontal         |
| Downlink Contour EIRP (dBW)                 | 46.5               | 46.5               | 46.5               | 46.5               |
| Rain Rate (mm/hr)                           | 95.0               | 95.0               | 95.0               | 95.0               |
| <b>ADJACENT SATELLITE 1</b>                 |                    |                    |                    |                    |
| Satellite 1 Orbital Location                | 40.9 E.L.          | 40.9 E.L.          | 40.9 E.L.          | 40.9 E.L.          |
| Uplink Power Density (dBW/Hz)               | -50.0              | -50.0              | -50.0              | -50.0              |
| Downlink EIRP Density (dBW/Hz)              | -26.0              | -26.0              | -26.0              | -26.0              |
| <b>ADJACENT SATELLITE 2</b>                 |                    |                    |                    |                    |
| Satellite 1 Orbital Location                | 44.9 E.L.          | 44.9 E.L.          | 44.9 E.L.          | 44.9 E.L.          |
| Uplink Power Density (dBW/Hz)               | -50.0              | -50.0              | -50.0              | -50.0              |
| Downlink EIRP Density (dBW/Hz)              | -26.0              | -26.0              | -26.0              | -26.0              |
| <b>CARRIER INFORMATION</b>                  |                    |                    |                    |                    |
| Carrier ID                                  | 27M0G7W            | 10M3G7W            | 100KG7W            | 1M45G7W            |
| Carrier Modulation                          | QPSK               | QPSK               | QPSK               | BPSK               |
| Peak to Peak Bandwidth of EDS (MHz)         | N/A                | N/A                | N/A                | N/A                |
| Information Rate(kbps)                      | 18432              | 6000               | 64                 | 512                |
| Code Rate                                   | 1/2x188/204        | 1/2x188/204        | 1/2x239/256        | R1/2               |
| Occupied Bandwidth(kHz)                     | 22600              | 6771.1             | 75.4               | 1229.0             |
| Allocated Bandwidth(kHz)                    | 27000              | 10300              | 100                | 1450.0             |
| Minimum C/N, Clear Sky (dB)                 | 3.4                | 3.9                | 3.0                | 3.4                |
| Minimum C/N, Rain (dB)                      | 3.4                | 3.6                | 2.8                | 2.7                |
| <b>UPLINK EARTH STATION</b>                 |                    |                    |                    |                    |
| Earth Station Diameter (meters)             | 6.1                | 6.1                | 6.1                | 6.1                |
| Earth Station Gain (dBi)                    | 56.7               | 56.7               | 56.7               | 56.7               |
| Earth Station Elevation Angle               | 20                 | 20                 | 20                 | 20                 |
| <b>DOWNLINK EARTH STATION</b>               |                    |                    |                    |                    |
| Earth Station Diameter (meters)             | 1.8                | 1.8                | 1.8                | 1.8                |
| Earth Station Gain (dBi)                    | 44.1               | 44.1               | 44.1               | 44.1               |
| Earth Station G/T (dB/K)                    | 21.6               | 21.6               | 21.6               | 21.6               |
| Earth Station Elevation Angle               | 20                 | 20                 | 20                 | 20                 |
| <b>LINK FADE TYPE</b>                       |                    |                    |                    |                    |
|   | Clear Sky          | Clear Sky          | Clear Sky          | Clear Sky          |
| <b>UPLINK PERFORMANCE</b>                   |                    |                    |                    |                    |
| Uplink Earth Station EIRP (dBW)             | 79.2               | 67.2               | 46.9               | 58.9               |
| Uplink Path Loss, Clear Sky (dB)            | -207.2             | -207.2             | -207.2             | -207.2             |
| Uplink Rain Attenuation                     | 0.0                | 0.0                | 0.0                | 0.0                |
| Satellite G/T(dB/K)                         | -2.8               | -2.8               | -2.8               | -2.8               |
| Boltzman Constant(dBW/K -Hz)                | 228.6              | 228.6              | 228.6              | 228.6              |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5              | -68.3              | -48.8              | -60.9              |
| Uplink C/N(dB)                              | 24.2               | 17.4               | 16.7               | 16.6               |
| <b>DOWNLINK PERFORMANCE</b>                 |                    |                    |                    |                    |
| Downlink EIRP per Carrier (dBW)             | 41.5               | 36.3               | 16.1               | 28.1               |
| Antenna Pointing Error (dB)                 | -.5                | -.5                | -.5                | -.5                |
| Downlink Path Loss, Clear Sky (dB)          | -205.3             | -205.3             | -205.3             | -205.3             |
| Downlink Rain Attenuation                   | 0.0                | 0.0                | 0.0                | 0.0                |
| Earth Station G/T (dB/K)                    | 21.6               | 21.6               | 21.6               | 21.6               |
| Boltzman Constant(dBW / K - Hz)             | 228.6              | 228.6              | 228.6              | 228.6              |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5              | -68.3              | -48.8              | -60.9              |
| Downlink C / N(dB)                          | 12.3               | 12.5               | 11.8               | 11.7               |
| <b>COMPOSITE LINK PERFORMANCE</b>           |                    |                    |                    |                    |
| C/N Uplink (dB)                             | 24.2               | 17.4               | 16.7               | 16.6               |
| C/N Downlink (dB)                           | 12.3               | 12.5               | 11.8               | 11.7               |
| C/I Intermodulation (dB)                    | N/A                | 14.6               | 13.9               | 13.8               |
| C/I Uplink Co-Channel (dB)*                 | 24.0               | 22.7               | 22.6               | 22.9               |
| C/I Downlink Co-Channel (dB)*               | 24.0               | 22.7               | 22.6               | 22.9               |
| C/I Uplink Adjacent Satellite 1 (dB)        | 29.7               | 22.9               | 22.2               | 22.0               |
| C/I Downlink Adjacent Satellite 1 (dB)      | 15.4               | 15.5               | 14.8               | 14.7               |
| C/I Uplink Adjacent Satellite 2 (dB)        | 29.7               | 22.9               | 22.2               | 22.0               |
| C/I Downlink Adjacent Satellite 2 (dB)      | 17.6               | 17.7               | 17.0               | 16.9               |
| C/(N+I) Composite (dB)                      | 9.3                | 7.6                | 6.9                | 6.8                |
| Required System Margin (dB)                 | -1.0               | -1.0               | -1.0               | -1.0               |
| Net C/(N+I) Composite (dB)                  | 8.3                | 6.6                | 5.9                | 5.8                |
| Minimum Required C/N (dB)                   | -3.4               | -3.9               | -3.0               | -3.4               |
| Excess Link Margin (dB)                     | 4.9                | 2.7                | 2.9                | 2.4                |
| <b>CARRIER DENSITY LEVELS</b>               |                    |                    |                    |                    |
| Uplink Power Density (dBW/Hz)               | -51.0              | -57.8              | -58.5              | -58.6              |
| Downlink EIRP Density At Beam Peak (dBW/Hz) | -26.1              | -26.0              | -26.7              | -26.8              |

## EXHIBIT 4: INTERFERENCE ANALYSIS (continued)

| <b>UPLINK BEAM INFORMATION</b>              |              |              |              |              |
|---|--------------|--------------|--------------|--------------|
| Uplink Beam Name                            | Africa       | Africa       | Africa       | Africa       |
| Uplink Frequency (MHz)                      | 14.0 – 14.25 | 14.0 – 14.25 | 14.0 – 14.25 | 14.0 – 14.25 |
| Uplink Beam Polarization                    | Horizontal   | Horizontal   | Horizontal   | Horizontal   |
| Uplink Contour G/T (dB/K)                   | -2.3         | -2.3         | -2.3         | -2.3         |
| Uplink SFD (dBW/m2)                         | -74.3        | -83.3        | -83.3        | -83.3        |
| Rain Rate (mm/hr)                           | 95.0         | 95.0         | 95.0         | 95.0         |
| <b>DOWNLINK BEAM INFORMATION</b>            |              |              |              |              |
| Downlink Beam Name                          | Africa       | Africa       | Africa       | Africa       |
| Downlink Frequency (MHz)                    | 10.95–11.20  | 10.95–11.20  | 10.95–11.20  | 10.95–11.20  |
| Downlink Beam Polarization                  | Vertical     | Vertical     | Vertical     | Vertical     |
| Downlink Contour EIRP (dBW)                 | 45.9         | 45.9         | 45.9         | 45.9         |
| Rain Rate (mm/hr)                           | 95.0         | 95.0         | 95.0         | 95.0         |
| <b>ADJACENT SATELLITE 1</b>                 |              |              |              |              |
| Satellite 1 Orbital Location                | 40.9 E.L.    | 40.9 E.L.    | 40.9 E.L.    | 40.9 E.L.    |
| Uplink Power Density (dBW/Hz)               | -50.0        | -50.0        | -50.0        | -50.0        |
| Downlink EIRP Density (dBW/Hz)              | -26.0        | -26.0        | -26.0        | -26.0        |
| <b>ADJACENT SATELLITE 2</b>                 |              |              |              |              |
| Satellite 1 Orbital Location                | 44.9 E.L.    | 44.9 E.L.    | 44.9 E.L.    | 44.9 E.L.    |
| Uplink Power Density (dBW/Hz)               | -50.0        | -50.0        | -50.0        | -50.0        |
| Downlink EIRP Density (dBW/Hz)              | -26.0        | -26.0        | -26.0        | -26.0        |
| <b>CARRIER INFORMATION</b>                  |              |              |              |              |
| Carrier ID                                  | 27M0G7W      | 10M3G7W      | 100KG7W      | 1M45G7W      |
| Carrier Modulation                          | QPSK         | QPSK         | QPSK         | BPSK         |
| Peak to Peak Bandwidth of EDS (MHz)         | N/A          | N/A          | N/A          | N/A          |
| Information Rate(kbps)                      | 18432        | 6000         | 64           | 512          |
| Code Rate                                   | 1/2x188/204  | 1/2x188/204  | 1/2x239/256  | R1/2         |
| Occupied Bandwidth(kHz)                     | 22600        | 6771.1       | 75.4         | 1229.0       |
| Allocated Bandwidth(kHz)                    | 27000        | 10300        | 100          | 1450.0       |
| Minimum C/N, Clear Sky (dB)                 | 3.4          | 3.9          | 3.0          | 3.4          |
| Minimum C/N, Rain (dB)                      | 3.4          | 3.6          | 2.8          | 2.7          |
| <b>UPLINK EARTH STATION</b>                 |              |              |              |              |
| Earth Station Diameter (meters)             | 6.1          | 6.1          | 6.1          | 6.1          |
| Earth Station Gain (dBi)                    | 56.8         | 56.8         | 56.8         | 56.8         |
| Earth Station Elevation Angle               | 20           | 20           | 20           | 20           |
| <b>DOWNLINK EARTH STATION</b>               |              |              |              |              |
| Earth Station Diameter (meters)             | 1.8          | 2.4          | 2.4          | 2.4          |
| Earth Station Gain (dBi)                    | 44.1         | 46.8         | 46.8         | 46.8         |
| Earth Station G/T (dB/K)                    | 21.6         | 24.3         | 24.3         | 24.3         |
| Earth Station Elevation Angle               | 20           | 20           | 20           | 20           |
| <b>LINK FADE TYPE</b>                       |              |              |              |              |
| Link Fade Type                              | Clear Sky    | Clear Sky    | Clear Sky    | Clear Sky    |
| <b>UPLINK PERFORMANCE</b>                   |              |              |              |              |
| Uplink Earth Station EIRP (dBW)             | 78.8         | 66.6         | 46.5         | 58.5         |
| Uplink Path Loss, Clear Sky (dB)            | -207.4       | -207.4       | -207.4       | -207.4       |
| Uplink Rain Attenuation                     | 0.0          | 0.0          | 0.0          | 0.0          |
| Satellite G/T(dB/K)                         | -2.3         | -2.3         | -2.3         | -2.3         |
| Boltzman Constant(dBW/K-Hz)                 | 228.6        | 228.6        | 228.6        | 228.6        |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5        | -68.3        | -48.8        | -60.9        |
| Uplink C/N(dB)                              | 24.2         | 17.2         | 16.7         | 16.5         |
| <b>DOWNLINK PERFORMANCE</b>                 |              |              |              |              |
| Downlink EIRP per Carrier (dBW)             | 41.5         | 36.3         | 16.2         | 28.2         |
| Antenna Pointing Error (dB)                 | -5           | -5           | -5           | -5           |
| Downlink Path Loss, Clear Sky (dB)          | -205.3       | -205.3       | -205.3       | -205.3       |
| Downlink Rain Attenuation                   | 0.0          | 0.0          | 0.0          | 0.0          |
| Earth Station G/T (dB/K)                    | 21.6         | 24.3         | 24.3         | 24.3         |
| Boltzman Constant(dBW / K - Hz)             | 228.6        | 228.6        | 228.6        | 228.6        |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5        | -68.3        | -48.8        | -60.9        |
| Downlink C / N(dB)                          | 12.4         | 15.1         | 14.6         | 14.4         |
| <b>COMPOSITE LINK PERFORMANCE</b>           |              |              |              |              |
| C/N Uplink (dB)                             | 24.2         | 17.2         | 16.7         | 16.5         |
| C/N Downlink (dB)                           | 12.4         | 15.1         | 14.6         | 14.4         |
| C/I Intermodulation (dB)                    | N/A          | 15.1         | 14.6         | 14.5         |
| C/I Uplink Co-Channel (dB)*                 | 24.0         | 23.2         | 23.3         | 23.6         |
| C/I Downlink Co-Channel (dB)*               | 24.0         | 23.2         | 23.3         | 23.6         |
| C/I Uplink Adjacent Satellite 1 (dB)        | 29.3         | 22.3         | 21.8         | 21.6         |
| C/I Downlink Adjacent Satellite 1 (dB)      | 15.4         | 18.4         | 17.9         | 17.8         |
| C/I Uplink Adjacent Satellite 2 (dB)        | 29.3         | 22.3         | 21.8         | 21.6         |
| C/I Downlink Adjacent Satellite 2 (dB)      | 17.6         | 20.1         | 19.6         | 19.4         |
| C/(N+I) Composite (dB)                      | 9.3          | 9.0          | 8.5          | 8.4          |
| Required System Margin (dB)                 | -1.0         | -1.0         | -1.0         | -1.0         |
| Net C/(N+I) Composite (dB)                  | 8.3          | 8.0          | 7.5          | 7.4          |
| Minimum Required C/N (dB)                   | -3.4         | -3.9         | -3.0         | -3.4         |
| Excess Link Margin (dB)                     | 4.9          | 4.1          | 4.5          | 4.0          |
| <b>CARRIER DENSITY LEVELS</b>               |              |              |              |              |
| Uplink Power Density (dBW/Hz)               | -51.6        | -58.6        | -59.1        | -59.2        |
| Downlink EIRP Density At Beam Peak (dBW/Hz) | -26.1        | -26.0        | -26.5        | -26.7        |

## EXHIBIT 4: INTERFERENCE ANALYSIS (continued)

| <b>UPLINK BEAM INFORMATION</b>              |               |               |               |               |
|---|---------------|---------------|---------------|---------------|
| Uplink Beam Name                            | Africa        | Africa        | Africa        | Africa        |
| Uplink Frequency (MHz)                      | 14.0 – 14.25  | 14.0 – 14.25  | 14.0 – 14.25  | 14.0 – 14.25  |
| Uplink Beam Polarization                    | Vertical      | Vertical      | Vertical      | Vertical      |
| Uplink Contour G/T (dB/K)                   | -1.7          | -1.7          | -1.7          | -1.7          |
| Uplink SFD (dBW/m2)                         | -75.9         | -82.9         | -82.9         | -82.9         |
| Rain Rate (mm/hr)                           | 95.0          | 95.0          | 95.0          | 95.0          |
| <b>DOWNLINK BEAM INFORMATION</b>            |               |               |               |               |
| Downlink Beam Name                          | Africa        | Africa        | Africa        | Africa        |
| Downlink Frequency (MHz)                    | 10.95 – 11.20 | 10.95 – 11.20 | 10.95 – 11.20 | 10.95 – 11.20 |
| Downlink Beam Polarization                  | Horizontal    | Horizontal    | Horizontal    | Horizontal    |
| Downlink Contour EIRP (dBW)                 | 46.5          | 46.5          | 46.5          | 46.5          |
| Rain Rate (mm/hr)                           | 95.0          | 95.0          | 95.0          | 95.0          |
| <b>ADJACENT SATELLITE 1</b>                 |               |               |               |               |
| Satellite 1 Orbital Location                | 40.9 E.L.     | 40.9 E.L.     | 40.9 E.L.     | 40.9 E.L.     |
| Uplink Power Density (dBW/Hz)               | -50.0         | -50.0         | -50.0         | -50.0         |
| Downlink EIRP Density (dBW/Hz)              | -26.0         | -26.0         | -26.0         | -26.0         |
| <b>ADJACENT SATELLITE 2</b>                 |               |               |               |               |
| Satellite 1 Orbital Location                | 44.9 E.L.     | 44.9 E.L.     | 44.9 E.L.     | 44.9 E.L.     |
| Uplink Power Density (dBW/Hz)               | -50.0         | -50.0         | -50.0         | -50.0         |
| Downlink EIRP Density (dBW/Hz)              | -26.0         | -26.0         | -26.0         | -26.0         |
| <b>CARRIER INFORMATION</b>                  |               |               |               |               |
| Carrier ID                                  | 27M0G7W       | 10M3G7W       | 100KG7W       | 1M45G7W       |
| Carrier Modulation                          | QPSK          | QPSK          | QPSK          | BPSK          |
| Peak to Peak Bandwidth of EDS (MHz)         | N/A           | N/A           | N/A           | N/A           |
| Information Rate(kbps)                      | 18432         | 6000          | 64            | 512           |
| Code Rate                                   | 1/2x188/204   | 1/2x188/204   | 1/2x239/256   | R1/2          |
| Occupied Bandwidth(kHz)                     | 22600         | 6771.1        | 75.4          | 1229.0        |
| Allocated Bandwidth(kHz)                    | 27000         | 10300         | 100           | 1450.0        |
| Minimum C/N, Clear Sky (dB)                 | 3.4           | 3.9           | 3.0           | 3.4           |
| Minimum C/N, Rain (dB)                      | 3.4           | 3.6           | 2.8           | 2.7           |
| <b>UPLINK EARTH STATION</b>                 |               |               |               |               |
| Earth Station Diameter (meters)             | 6.1           | 6.1           | 6.1           | 6.1           |
| Earth Station Gain (dBi)                    | 56.8          | 56.8          | 56.8          | 56.8          |
| Earth Station Elevation Angle               | 20            | 20            | 20            | 20            |
| <b>DOWNLINK EARTH STATION</b>               |               |               |               |               |
| Earth Station Diameter (meters)             | 1.8           | 2.4           | 2.4           | 2.4           |
| Earth Station Gain (dBi)                    | 44.1          | 46.8          | 46.8          | 46.8          |
| Earth Station G/T (dB/K)                    | 21.6          | 24.3          | 24.3          | 24.3          |
| Earth Station Elevation Angle               | 20            | 20            | 20            | 20            |
| <b>LINK FADE TYPE</b>                       |               |               |               |               |
|   | Clear Sky     | Clear Sky     | Clear Sky     | Clear Sky     |
| <b>UPLINK PERFORMANCE</b>                   |               |               |               |               |
| Uplink Earth Station EIRP (dBW)             | 76.5          | 66.3          | 46.1          | 58.1          |
| Uplink Path Loss, Clear Sky (dB)            | -207.4        | -207.4        | -207.4        | -207.4        |
| Uplink Rain Attenuation                     | 0.0           | 0.0           | 0.0           | 0.0           |
| Satellite G/T(dB/K)                         | -1.7          | -1.7          | -1.7          | -1.7          |
| Boltzman Constant(dBW/K - Hz)               | 228.6         | 228.6         | 228.6         | 228.6         |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5         | -68.3         | -48.8         | -60.9         |
| Uplink C/N(dB)                              | 22.5          | 17.5          | 16.9          | 16.7          |
| <b>DOWNLINK PERFORMANCE</b>                 |               |               |               |               |
| Downlink EIRP per Carrier (dBW)             | 41.5          | 36.2          | 16.0          | 28.0          |
| Antenna Pointing Error (dB)                 | -.5           | -.5           | -.5           | -.5           |
| Downlink Path Loss, Clear Sky (dB)          | -205.3        | -205.3        | -205.3        | -205.3        |
| Downlink Rain Attenuation                   | 0.0           | 0.0           | 0.0           | 0.0           |
| Earth Station G/T (dB/K)                    | 21.6          | 24.3          | 24.3          | 24.3          |
| Boltzman Constant(dBW / K - Hz)             | 228.6         | 228.6         | 228.6         | 228.6         |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5         | -68.3         | -48.8         | -60.9         |
| Downlink C / N(dB)                          | 12.3          | 15.0          | 14.4          | 14.2          |
| <b>COMPOSITE LINK PERFORMANCE</b>           |               |               |               |               |
| C/N Uplink (dB)                             | 22.5          | 17.5          | 16.9          | 16.7          |
| C/N Downlink (dB)                           | 12.3          | 15.0          | 14.4          | 14.2          |
| C/I Intermodulation (dB)                    | N/A           | 14.4          | 13.8          | 13.7          |
| C/I Uplink Co-Channel (dB)*                 | 24.0          | 22.5          | 22.5          | 22.8          |
| C/I Downlink Co-Channel (dB)*               | 24.0          | 22.5          | 22.5          | 22.8          |
| C/I Uplink Adjacent Satellite 1 (dB)        | 27.0          | 22.0          | 21.4          | 21.2          |
| C/I Downlink Adjacent Satellite 1 (dB)      | 15.4          | 18.3          | 17.7          | 17.6          |
| C/I Uplink Adjacent Satellite 2 (dB)        | 27.0          | 22.0          | 21.4          | 21.2          |
| C/I Downlink Adjacent Satellite 2 (dB)      | 17.6          | 20.0          | 19.4          | 19.2          |
| C/(N+I) Composite (dB)                      | 9.1           | 8.7           | 8.2           | 8.1           |
| Required System Margin (dB)                 | -1.0          | -1.0          | -1.0          | -1.0          |
| Net C/(N+I) Composite (dB)                  | 8.1           | 7.7           | 7.2           | 7.1           |
| Minimum Required C/N (dB)                   | -3.4          | -3.9          | -3.0          | -3.4          |
| Excess Link Margin (dB)                     | 4.8           | 3.8           | 4.2           | 3.7           |
| <b>CARRIER DENSITY LEVELS</b>               |               |               |               |               |
| Uplink Power Density (dBW/Hz)               | -53.9         | -58.9         | -59.4         | -59.6         |
| Downlink EIRP Density At Beam Peak (dBW/Hz) | -26.1         | -26.1         | -26.7         | -26.9         |

## EXHIBIT 4: INTERFERENCE ANALYSIS (continued)

| <b>UPLINK BEAM INFORMATION</b>              |                    |                    |                    |                    |
|---|--------------------|--------------------|--------------------|--------------------|
| Uplink Beam Name                            | Africa             | Africa             | Africa             | Africa             |
| Uplink Frequency (MHz)                      | 14.0 – 14.25       | 14.0 – 14.25       | 14.0 – 14.25       | 14.0 – 14.25       |
| Uplink Beam Polarization                    | Horizontal         | Horizontal         | Horizontal         | Horizontal         |
| Uplink Contour G/T (dB/K)                   | -2.3               | -2.3               | -2.3               | -2.3               |
| Uplink SFD (dBW/m2)                         | -74.3              | -84.3              | -84.3              | -84.3              |
| Rain Rate (mm/hr)                           | 95.0               | 95.0               | 95.0               | 95.0               |
| <b>DOWNLINK BEAM INFORMATION</b>            |                    |                    |                    |                    |
| Downlink Beam Name                          | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe |
| Downlink Frequency (MHz)                    | 10.95 – 11.20      | 10.95 – 11.20      | 10.95 – 11.20      | 10.95 – 11.20      |
| Downlink Beam Polarization                  | Vertical           | Vertical           | Vertical           | Vertical           |
| Downlink Contour EIRP (dBW)                 | 46.0               | 46.0               | 46.0               | 46.0               |
| Rain Rate (mm/hr)                           | 42.0               | 42.0               | 42.0               | 42.0               |
| <b>ADJACENT SATELLITE 1</b>                 |                    |                    |                    |                    |
| Satellite 1 Orbital Location                | 40.9 E.L.          | 40.9 E.L.          | 40.9 E.L.          | 40.9 E.L.          |
| Uplink Power Density (dBW/Hz)               | -50.0              | -50.0              | -50.0              | -50.0              |
| Downlink EIRP Density (dBW/Hz)              | -26.0              | -26.0              | -26.0              | -26.0              |
| <b>ADJACENT SATELLITE 2</b>                 |                    |                    |                    |                    |
| Satellite 1 Orbital Location                | 44.9 E.L.          | 44.9 E.L.          | 44.9 E.L.          | 44.9 E.L.          |
| Uplink Power Density (dBW/Hz)               | -50.0              | -50.0              | -50.0              | -50.0              |
| Downlink EIRP Density (dBW/Hz)              | -26.0              | -26.0              | -26.0              | -26.0              |
| <b>CARRIER INFORMATION</b>                  |                    |                    |                    |                    |
| Carrier ID                                  | 27M0G7W            | 10M3G7W            | 100KG7W            | 1M45G7W            |
| Carrier Modulation                          | QPSK               | QPSK               | QPSK               | BPSK               |
| Peak to Peak Bandwidth of EDS (MHz)         | N/A                | N/A                | N/A                | N/A                |
| Information Rate(kbps)                      | 18432              | 6000               | 64                 | 512                |
| Code Rate                                   | 1/2x188/204        | 1/2x188/204        | 1/2x239/256        | R1/2               |
| Occupied Bandwidth(kHz)                     | 22600              | 6771.1             | 75.4               | 1229.0             |
| Allocated Bandwidth(kHz)                    | 27000              | 10300              | 100                | 1450.0             |
| Minimum C/N, Clear Sky (dB)                 | 3.4                | 3.9                | 3.0                | 3.4                |
| Minimum C/N, Rain (dB)                      | 3.4                | 3.6                | 2.8                | 2.7                |
| <b>UPLINK EARTH STATION</b>                 |                    |                    |                    |                    |
| Earth Station Diameter (meters)             | 6.1                | 6.1                | 6.1                | 6.1                |
| Earth Station Gain (dBi)                    | 56.8               | 56.8               | 56.8               | 56.8               |
| Earth Station Elevation Angle               | 20                 | 20                 | 20                 | 20                 |
| <b>DOWNLINK EARTH STATION</b>               |                    |                    |                    |                    |
| Earth Station Diameter (meters)             | 1.8                | 2.4                | 2.4                | 2.4                |
| Earth Station Gain (dBi)                    | 44.1               | 46.8               | 46.8               | 46.8               |
| Earth Station G/T (dB/K)                    | 21.6               | 24.3               | 24.3               | 24.3               |
| Earth Station Elevation Angle               | 20                 | 20                 | 20                 | 20                 |
| <b>LINK FADE TYPE</b>                       |                    |                    |                    |                    |
|   | Clear Sky          | Clear Sky          | Clear Sky          | Clear Sky          |
| <b>UPLINK PERFORMANCE</b>                   |                    |                    |                    |                    |
| Uplink Earth Station EIRP (dBW)             | 78.6               | 65.5               | 45.4               | 57.4               |
| Uplink Path Loss, Clear Sky (dB)            | -207.4             | -207.4             | -207.4             | -207.4             |
| Uplink Rain Attenuation                     | 0.0                | 0.0                | 0.0                | 0.0                |
| Satellite G/T(dB/K)                         | -2.3               | -2.3               | -2.3               | -2.3               |
| Boltzman Constant(dBW/K - Hz)               | 228.6              | 228.6              | 228.6              | 228.6              |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5              | -68.3              | -48.8              | -60.9              |
| Uplink C/N(dB)                              | 24.0               | 16.1               | 15.6               | 15.4               |
| <b>DOWNLINK PERFORMANCE</b>                 |                    |                    |                    |                    |
| Downlink EIRP per Carrier (dBW)             | 41.4               | 36.3               | 16.2               | 28.2               |
| Antenna Pointing Error (dB)                 | -.5                | -.5                | -.5                | -.5                |
| Downlink Path Loss, Clear Sky (dB)          | -205.3             | -205.3             | -205.3             | -205.3             |
| Downlink Rain Attenuation                   | 0.0                | 0.0                | 0.0                | 0.0                |
| Earth Station G/T (dB/K)                    | 21.6               | 24.3               | 24.3               | 24.3               |
| Boltzman Constant(dBW / K - Hz)             | 228.6              | 228.6              | 228.6              | 228.6              |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5              | -68.3              | -48.8              | -60.9              |
| Downlink C / N(dB)                          | 12.3               | 15.1               | 14.6               | 14.4               |
| <b>COMPOSITE LINK PERFORMANCE</b>           |                    |                    |                    |                    |
| C/N Uplink (dB)                             | 24.0               | 16.1               | 15.6               | 15.4               |
| C/N Downlink (dB)                           | 12.3               | 15.1               | 14.6               | 14.4               |
| C/I Intermodulation (dB)                    | N/A                | 15.0               | 14.5               | 14.4               |
| C/I Uplink Co-Channel (dB)*                 | 24.0               | 23.1               | 23.1               | 23.5               |
| C/I Downlink Co-Channel (dB)*               | 24.0               | 23.1               | 23.1               | 23.5               |
| C/I Uplink Adjacent Satellite 1 (dB)        | 29.1               | 21.2               | 20.7               | 20.5               |
| C/I Downlink Adjacent Satellite 1 (dB)      | 15.3               | 18.4               | 17.9               | 17.8               |
| C/I Uplink Adjacent Satellite 2 (dB)        | 29.1               | 21.2               | 20.7               | 20.5               |
| C/I Downlink Adjacent Satellite 2 (dB)      | 17.5               | 20.1               | 19.6               | 19.4               |
| C/(N+I) Composite (dB)                      | 9.2                | 8.7                | 8.2                | 8.0                |
| Required System Margin (dB)                 | -1.0               | -1.0               | -1.0               | -1.0               |
| Net C/(N+I) Composite (dB)                  | 8.2                | 7.7                | 7.2                | 7.0                |
| Minimum Required C/N (dB)                   | -3.4               | -3.9               | -3.0               | -3.4               |
| Excess Link Margin (dB)                     | 4.8                | 3.8                | 4.2                | 3.6                |
| <b>CARRIER DENSITY LEVELS</b>               |                    |                    |                    |                    |
| Uplink Power Density (dBW/Hz)               | -51.8              | -59.7              | -60.2              | -60.3              |
| Downlink EIRP Density At Beam Peak (dBW/Hz) | -26.1              | -26.0              | -26.6              | -26.7              |

## EXHIBIT 4: INTERFERENCE ANALYSIS (continued)

| <b>UPLINK BEAM INFORMATION</b>              |                    |                    |                    |                    |
|---|--------------------|--------------------|--------------------|--------------------|
| Uplink Beam Name                            | Africa             | Africa             | Africa             | Africa             |
| Uplink Frequency (MHz)                      | 14.0 – 14.25       | 14.0 – 14.25       | 14.0 – 14.25       | 14.0 – 14.25       |
| Uplink Beam Polarization                    | Vertical           | Vertical           | Vertical           | Vertical           |
| Uplink Contour G/T (dB/K)                   | -1.7               | -1.7               | -1.7               | -1.7               |
| Uplink SFD (dBW/m2)                         | -75.9              | -80.9              | -80.9              | -80.9              |
| Rain Rate (mm/hr)                           | 95.0               | 95.0               | 95.0               | 95.0               |
| <b>DOWNLINK BEAM INFORMATION</b>            |                    |                    |                    |                    |
| Downlink Beam Name                          | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe | Extended Ku Europe |
| Downlink Frequency (MHz)                    | 10.95 – 11.20      | 10.95 – 11.20      | 10.95 – 11.20      | 10.95 – 11.20      |
| Downlink Beam Polarization                  | Horizontal         | Horizontal         | Horizontal         | Horizontal         |
| Downlink Contour EIRP (dBW)                 | 46.1               | 46.1               | 46.1               | 46.1               |
| Rain Rate (mm/hr)                           | 42.0               | 42.0               | 42.0               | 42.0               |
| <b>ADJACENT SATELLITE 1</b>                 |                    |                    |                    |                    |
| Satellite 1 Orbital Location                | 40.9 E.L.          | 40.9 E.L.          | 40.9 E.L.          | 40.9 E.L.          |
| Uplink Power Density (dBW/Hz)               | -50.0              | -50.0              | -50.0              | -50.0              |
| Downlink EIRP Density (dBW/Hz)              | -26.0              | -26.0              | -26.0              | -26.0              |
| <b>ADJACENT SATELLITE 2</b>                 |                    |                    |                    |                    |
| Satellite 1 Orbital Location                | 44.9 E.L.          | 44.9 E.L.          | 44.9 E.L.          | 44.9 E.L.          |
| Uplink Power Density (dBW/Hz)               | -50.0              | -50.0              | -50.0              | -50.0              |
| Downlink EIRP Density (dBW/Hz)              | -26.0              | -26.0              | -26.0              | -26.0              |
| <b>CARRIER INFORMATION</b>                  |                    |                    |                    |                    |
| Carrier ID                                  | 27M0G7W            | 10M3G7W            | 100KG7W            | 1M45G7W            |
| Carrier Modulation                          | QPSK               | QPSK               | QPSK               | BPSK               |
| Peak to Peak Bandwidth of EDS (MHz)         | N/A                | N/A                | N/A                | N/A                |
| Information Rate(kbps)                      | 18432              | 6000               | 64                 | 512                |
| Code Rate                                   | 1/2x188/204        | 1/2x188/204        | 1/2x239/256        | R1/2               |
| Occupied Bandwidth(kHz)                     | 22600              | 6771.1             | 75.4               | 1229.0             |
| Allocated Bandwidth(kHz)                    | 27000              | 10300              | 100                | 1450.0             |
| Minimum C/N, Clear Sky (dB)                 | 3.4                | 3.9                | 3.0                | 3.4                |
| Minimum C/N, Rain (dB)                      | 3.4                | 3.6                | 2.8                | 2.7                |
| <b>UPLINK EARTH STATION</b>                 |                    |                    |                    |                    |
| Earth Station Diameter (meters)             | 6.1                | 6.1                | 6.1                | 6.1                |
| Earth Station Gain (dBi)                    | 56.8               | 56.8               | 56.8               | 56.8               |
| Earth Station Elevation Angle               | 20                 | 20                 | 20                 | 20                 |
| <b>DOWNLINK EARTH STATION</b>               |                    |                    |                    |                    |
| Earth Station Diameter (meters)             | 1.8                | 2.4                | 1.8                | 1.8                |
| Earth Station Gain (dBi)                    | 44.1               | 46.8               | 44.1               | 44.1               |
| Earth Station G/T (dB/K)                    | 21.6               | 24.3               | 21.6               | 21.6               |
| Earth Station Elevation Angle               | 20                 | 20                 | 20                 | 20                 |
| <b>LINK FADE TYPE</b>                       |                    |                    |                    |                    |
|   | Clear Sky          | Clear Sky          | Clear Sky          | Clear Sky          |
| <b>UPLINK PERFORMANCE</b>                   |                    |                    |                    |                    |
| Uplink Earth Station EIRP (dBW)             | 77.0               | 67.9               | 49.3               | 61.2               |
| Uplink Path Loss, Clear Sky (dB)            | -207.4             | -207.4             | -207.4             | -207.4             |
| Uplink Rain Attenuation                     | 0.0                | 0.0                | 0.0                | 0.0                |
| Satellite G/T(dB/K)                         | -1.7               | -1.7               | -1.7               | -1.7               |
| Boltzman Constant(dBW/K - Hz)               | 228.6              | 228.6              | 228.6              | 228.6              |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5              | -68.3              | -48.8              | -60.9              |
| Uplink C/N(dB)                              | 23.0               | 19.1               | 20.0               | 19.8               |
| <b>DOWNLINK PERFORMANCE</b>                 |                    |                    |                    |                    |
| Downlink EIRP per Carrier (dBW)             | 41.5               | 35.4               | 16.8               | 28.7               |
| Antenna Pointing Error (dB)                 | -.5                | -.5                | -.5                | -.5                |
| Downlink Path Loss, Clear Sky (dB)          | -205.3             | -205.3             | -205.3             | -205.3             |
| Downlink Rain Attenuation                   | 0.0                | 0.0                | 0.0                | 0.0                |
| Earth Station G/T (dB/K)                    | 21.6               | 24.3               | 21.6               | 21.6               |
| Boltzman Constant(dBW / K - Hz)             | 228.6              | 228.6              | 228.6              | 228.6              |
| Carrier Noise Bandwidth (dB-Hz)             | -73.5              | -68.3              | -48.8              | -60.9              |
| Downlink C / N(dB)                          | 12.4               | 14.2               | 12.4               | 12.3               |
| <b>COMPOSITE LINK PERFORMANCE</b>           |                    |                    |                    |                    |
| C/N Uplink (dB)                             | 23.0               | 19.1               | 20.0               | 19.8               |
| C/N Downlink (dB)                           | 12.4               | 14.2               | 12.4               | 12.3               |
| C/I Intermodulation (dB)                    | N/A                | 14.1               | 15.0               | 14.8               |
| C/I Uplink Co-Channel (dB)*                 | 24.0               | 22.1               | 23.6               | 23.9               |
| C/I Downlink Co-Channel (dB)*               | 24.0               | 22.1               | 23.6               | 23.9               |
| C/I Uplink Adjacent Satellite 1 (dB)        | 27.5               | 23.6               | 24.5               | 24.3               |
| C/I Downlink Adjacent Satellite 1 (dB)      | 15.4               | 16.6               | 15.5               | 15.3               |
| C/I Uplink Adjacent Satellite 2 (dB)        | 27.5               | 23.6               | 24.5               | 24.3               |
| C/I Downlink Adjacent Satellite 2 (dB)      | 17.6               | 18.5               | 17.7               | 17.5               |
| C/(N+I) Composite (dB)                      | 9.2                | 8.3                | 7.9                | 7.8                |
| Required System Margin (dB)                 | -1.0               | -1.0               | -1.0               | -1.0               |
| Net C/(N+I) Composite (dB)                  | 8.2                | 7.3                | 6.9                | 6.8                |
| Minimum Required C/N (dB)                   | -3.4               | -3.9               | -3.0               | -3.4               |
| Excess Link Margin (dB)                     | 4.8                | 3.4                | 4.0                | 3.4                |
| <b>CARRIER DENSITY LEVELS</b>               |                    |                    |                    |                    |
| Uplink Power Density (dBW/Hz)               | -53.4              | -57.2              | -56.3              | -56.5              |
| Downlink EIRP Density At Beam Peak (dBW/Hz) | -26.0              | -26.9              | -26.0              | -26.2              |