A Coordination Agreement Between the National Aeronautics and Space Administration (hereinafter "NASA") and Astrium Services Government, Inc. f/k/a Vizada, Inc. (hereinafter "ASGI") for Operation of Earth Stations on Board Vessels (ESV) in the 14.0 – 14.5 GHz-Band

ASGI is licensed to operate Earth Stations on Board Vessels (ESV) in the Atlantic Ocean Region and the Pacific Ocean Region in the 14.0 to 14.5 GHz FSS band. This Coordination Agreement has been prepared in compliance with the rules of the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA).

1. Overview

1.1 The 14.0 – 14.5 GHz-band has been allocated to the fixed and mobile-satellite services. FCC rules (Report and Order FCC 09-64) require those commercial companies planning to provide ESV services in the US or its possessions to protect Space Research Service (SRS) earth stations and the NASA Tracking and Data Relay Satellite System (TDRSS). The TDRSS downlink carrier frequencies are situated in the 13.40 – 14.2 GHz Space Research Service band.

1.2 ASGI has license authorization with the FCC to operate ESV terminals in the 14.0 – 14.5 GHz-band. ASGI seeks coordination with NASA for operation of ESVs in the 14.0 – 14.2 GHz frequency bands within 125 km of protected TDRSS facilities.

1.3 Each terminal that transmits in the 14.0-14.5 GHz band will contain a GPS receiver (or will require manual entry of coordinates) that will enable the terminal operator to know the terminal position at any time. This knowledge of real-time terminal position will enable the operator to avoid geographic areas where interference could be caused to NASA TDRSS earth stations.

1.4 This Coordination Agreement has been prepared to ensure that operation of ESV terminals will conform to FCC requirements for protection of the NASA TDRSS.

1.5 ASGI has the authority to negotiate and sign this Coordination Agreement for ESV terminals communicating with ASGI earth stations and NASA has the authority to negotiate and sign this agreement for the TDRSS sites listed in Section 3.

2. AUTHORITY

2.1 NASA concludes this agreement pursuant to 42 USC §2473 (c) (5) and (6) and section 203 (c) (5) of the National Aeronautics and Space Act of 1958 as amended, in addition to the Manual of Regulations and Procedures for Federal Radio Frequency Management (National Telecommunications & Information Administration Redbook), January 2008 Edition, May 2010 Revisions.

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3. Space Research Services Earth Stations

3.1 TDRSS Earth Station Sites

Table 1 on the next page provides a list of TDRSS Earth Station sites requiring interference protection. The station located at Blossom Point (BP), MD is currently under development and is expected to begin operations in January 2012. Once the BP station begins operations, it will require protection.

3.2 Additional TDRSS Earth Station Sites

NASA may unilaterally add additional TDRSS earth station sites to the list in Table 1. NASA shall provide ASGI at least six months written notice of additional stations that will use the 13.40 – 14.2 GHz-band. Additionally, NASA shall inform ASGI of the operational date for the BP station at least 30 days in advance of actual BP operations. In emergency situations, such notice may be significantly shorter.

3.3 Earth Site Protection Limits

The TDRSS protection limits for ground based interference from ESV terminals are listed in Table 2 below. Since ESV terminals will not likely be used in close proximity of TDRSS terminals, and are not expected to be illuminated by the TDRSS earth station antenna main beam gain, RF saturation need not be considered.

The interference level (I) shown in Table 2 represents the aggregate of all interferences from all ESV terminals that may be operating within interference range of a TDRSS earth station. For purposes of interference budget allocation to the various ESV service providers, it will be assumed that ESV terminals operating in the environment of each TDRSS earth station site will be licensed by four (4) different commercial companies. Therefore, for purposes of interference analysis, each company will be allocated an interference budget of 25% (or 6 dB less than) of the I/N values shown in Table 2. The resulting I/N for each ESV provider refers to the aggregate interference from all ESV terminals operated by that specific ESV service provider. For this agreement, this means aggregate interference from all ASGI ESV terminals operating within interference range of a TDRSS earth station.

Earth Station	Latitude, Longitude, Altitude, Antenna size and gain
Blossom Point (BP), MD	38.4289N, 77.0839W, 4m Antenna size – 20 meters Antenna gain – 67.2 dBi
Guam	13.5881N, 144.8410E, 129m Antenna size – 11 meters Antenna gain – 61.9 dBi

Table 1: TDRSS Earth Station Locations

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Frequency Band	Aggregate Interference-to-Noise (I/N) Threshold Limit in dB referred to the IF Output (6 dB less per operator)	TDRSS Earth Station Site Location
14.0 – 14.2 GHz	- 15.3	BP
14.0 – 14.2 GHz	-14.9	Guam

Table 2: TDRSS Protection Limits

TDRSS spacecraft orbit positions vary slightly over time depending on the East-West tolerance of each spacecraft and the health of the TDRSS constellation. For purposes of calculating ESV interference levels and the required interference distance separations as a function of azimuth around each site, and to ensure that TDRSS earth station communications with future TDRSS spacecraft can be protected, calculations will be conducted to protect earth station operation with all usable TDRSS orbit locations. Useable orbit locations are defined to be those that are at an elevation angle of at least 5 degrees for the BP site, and at an elevation angle of at least 3 degrees for the Guam site. Additionally, in calculating interference power levels, the TDRSS earth station antenna receive patterns in Figure 1 will be used.

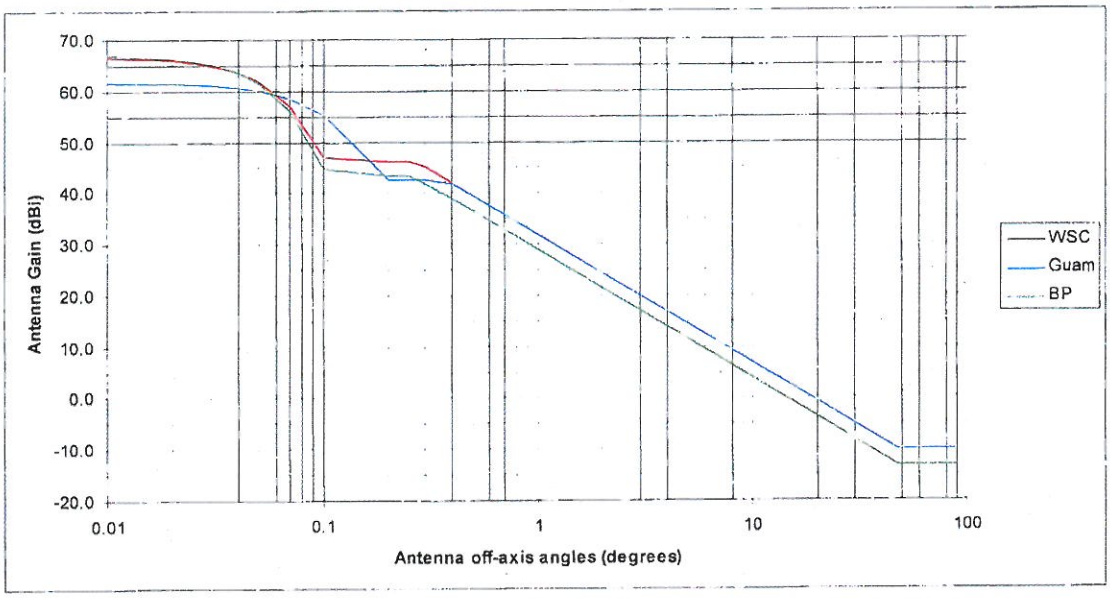

Figure 1: TDRSS Earth Station Antenna Gain Patterns

The antenna patterns shown in Figure 1 for the existing Guam site are calculated using Annex III of Appendix 8 of the ITU Radio Regulations, with the following conditions:

$G_1 = 5 + 15\log(D/\lambda)$

$\varphi_r = 12.02\,(D/\lambda)^{-0.6}$

where Gmax and D are given in Table 1.

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In the case of the BP site, the antenna pattern in ITU F.1245 is used which has sidelobes up to 3 dB less than those obtained with Annex 3 of Appendix 8 for large off-axis angles. For this pattern,

$G_1 = 2 + 15\log(D/\lambda)$ and

$\varphi_r = 12.02\ (D/\lambda)^{-0.6}$

In calculating interference levels, propagation loss will be calculated using the NTIA Irregular Terrain Model (ITM) and actual terrain elevations will be considered. The above procedures will be used to calculate a set of distance separations that need to be avoided around each of the TDRSS earth station sites. The resulting separation distances vary according to the terminal technical parameters of each service provider, and the operating GSO orbit positions planned for use by each provider. The resulting distances are also a function of the azimuth around each TDRSS site and the nature of the terrain around each site. These procedures will be used by NASA to calculate areas around each TDRSS site that will cause unacceptable interference to the TDRSS. In this particular case, the calculations will be based on sensitive or proprietary ASGI and NASA information.

4. Operational Coordination Agreement

4.1 NASA and ASGI agree to the following:

a. The purpose of this Coordination Agreement is to provide protection to the TDRSS Earth Station sites listed in Table 1 and any future TDRSS Earth Station sites.

b. The level of protection afforded to the sites in Table 1, and any future TDRSS earth station sites which NASA requires pursuant to Section 3.2 of this Agreement, shall be equal to or greater than the Interference Threshold Limits shown in Table 2.

4.2 This Coordination Agreement may be reviewed periodically by the signatories to the agreement. The purpose of the review is to assess the effectiveness of this agreement and update this, or subordinate operational agreements, as appropriate.

4.3 Each party shall inform the other party in a timely manner of changes in the points of contact as defined in Section 5.

4.4 FINANCIAL OBLIGATIONS: Each party shall be responsible for funding its own responsibilities under this Agreement. No provision of this Agreement shall be interpreted to require obligation of funds in violation of the Anti-Deficiency Act 31 U.S.C § 1341.

ASGI agrees to:

4.5 Monitor, control and cease transmissions from any ASGI ESV terminal that would exceed the thresholds given in Table 2 to any of the earth station sites listed in Table 1.

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4.6 Monitor, control and cease transmissions from any ASGI ESV terminal that would exceed the thresholds given in Table 2 to any additional sites that NASA may require.

4.7 Respond expeditiously to a NASA request for protection of the sites listed in Table 1, or any additional site that may be identified by NASA.

4.8 Respond expeditiously to a NASA request to isolate a source of interference to a TDRSS Earth Station suspected to be from a ASGI ESV terminal.

4.9 Provide a central point of contact (on a 24 hour, 7 day basis) for interference resolution and other contact purposes.

NASA agrees to:

4.10 Maintain an open dialog with ASGI concerning any perceived breach of interference thresholds that may be attributable to a ASGI ESV terminal that is not in compliance with this Coordination Agreement.

4.11 Provide timely notification to ASGI of changes or additions to TDRSS earth station sites, or interference thresholds listed in this Coordination Agreement.

5. Assignment and Termination

5.1 This Coordination Agreement shall be binding upon the parties hereto and their respective successors and assigns.

5.2 This Coordination Agreement may be terminated by either party upon 6 months written notice to the other.

5.3 CONTINUING OBLIGATIONS: The obligation of ASGI to protect the NASA TDRSS Earth Stations from interference as described in this agreement and pursuant to FCC rules and regulations will survive termination or expiration of this Agreement.

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6. Points of Contact

6.1 Points of contact concerning this Coordination Agreement:

Name:	Victor Sparrow
Organization:	NASA HQ
Title:	Director, NASA Spectrum Policy
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Phone:	(202) 358-4808
Fax:	(202) 358-2865
E-mail:	Victor.D.Sparrow@nasa.gov

Primary Contact
Name: Rob Swanson
Organization: ASGI
Title: Associate Counsel
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Phone: (301)838-7807
Fax: (301)838-7752
E-mail: rob.swanson@astrium.eads-na.com

6.2 Points of contact for technical concerns related to this Coordination Agreement:

Name:	Vincent S. Galbraith
Organization:	NASA GSFC
Title:	GSFC Spectrum Manager
Address:	Goddard Space Flight Center Mission Services Program Office Greenbelt, MD 20771
Phone:	(301) 286-5089
Fax:	(301) 286-1724
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Primary Contact
Name: Chris Hetmanski
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Title: Chief Technical Officer
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Fax: (301)838-7752
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7 Signatures

This Coordination Agreement is being made in good faith by both parties and is effective on the date on of final signature.

For: The National Aeronautics and Space Administration

By: Victor D Sparrow

Name: Victor Sparrow

Title: Director, NASA Spectrum Policy

Date: 2/4/2013

For: Astrium Services Government, Inc.

By: Robert Baker

Name: Robert Baker

Title: CEO, ASGI Americas

Date: 12/17/2012

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