Prepared for the Federal Communications Commission

Application for License Authority for

Earth Stations on Board Vessels

Data Technology Solutions, LLC.

September 30, 2010

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INTRODUCTION

Data Technology Solutions, LLC. ("DTS"), pursuant to 47 C.F.R. § 25.115 of the Rules and Regulations ("Regulations") of the Federal Communications Commission ("Commission"), respectfully requests the issuance of a new of license to operate 250 Ku-Band Earth Station on Vessels ("ESVs") throughout US channels and waterways, the Gulf of Mexico, the Caribbean Sea, the Atlantic Ocean, and the Pacific Ocean. The proposed ESVs seek to operate in the 11.7-12.2 GHz and 14.0-14.5 GHz ("Ku-Band") frequency bands to communicate with an already licensed hub station located in the United States.

The proposed remote antenna is a 60cm Ku-Band model AZU-06 manufactured by Azimuth Unlimited, LLC ("AZIMUTH AZU-06 Antenna") capable of providing stabilized tracking. The AZIMUTH AZU-06 Antenna does not strictly comply with Section 25.209 of the Regulations. Consequently, DTS will operate the ESV terminals at a reduced transmit power so as to decrease the off-axis Effective Isotropic Radiated Power (EIRP) density.

The antenna manufacturer, Azimuth Unlimited, LLC, tested the AZIMUTH AZU-06 Antenna and generated the EIRP spectral density plots here presented. Furthermore, Azimuth Unlimited, LLC has declared that if the input power density to the AZIMUTH AZU-06 Antenna is limited to -21.4 dBW/4KHz, the antenna will meet the requirements of Section 25.222 of the Regulations. The report here presented as well as the enclosed attachments and exhibits address the requirements of Section 25.222 of the Regulations as well as the underlying ESV Order.[1]

§25.222 (a)(7) ANTENNA POINTING ERROR

"All emissions from the ESV shall automatically cease within 100 milliseconds if the line angle between the orbital location of the target satellite and the axis of the main lobe of the ESV antenna exceeds 0.5°, and transmission will not resume until such angle is less than 0.2°." 47 C.F.R §25.222(a)(7).

In the event of an off-axis deviation exceeding 0.5°, the above-deck pedestal of the AZIMUTH AZU-06 Antenna will send a "cease transmissions" signal by providing a TX MUTE instruction to the below-deck satellite modem. This action occurs within 100 milliseconds of the off-axis exceeding 0.5°. Antenna controllers then suppress the signal until the off-axis angle is within 0.2° of the target satellite.

The stabilized antenna systems employs closed-loop servo systems and highly accurate sensors with a resolution of better than 0.01° to continuously monitor the antenna's position in inertial space. The servo mechanism keeps the antenna pointing within ± 0.1° RMS. The pointing accuracy is approximately 0.15° peak as shown in the figure below.

[1] *In the Matter of Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/3700-4200 MHz Bands and 14.0-14.5 Ghz/11.7-12.2 GHz Bands*, Report and Order, FCC 204-286, Adopted December 15, 2004, Released January 6, 2005.

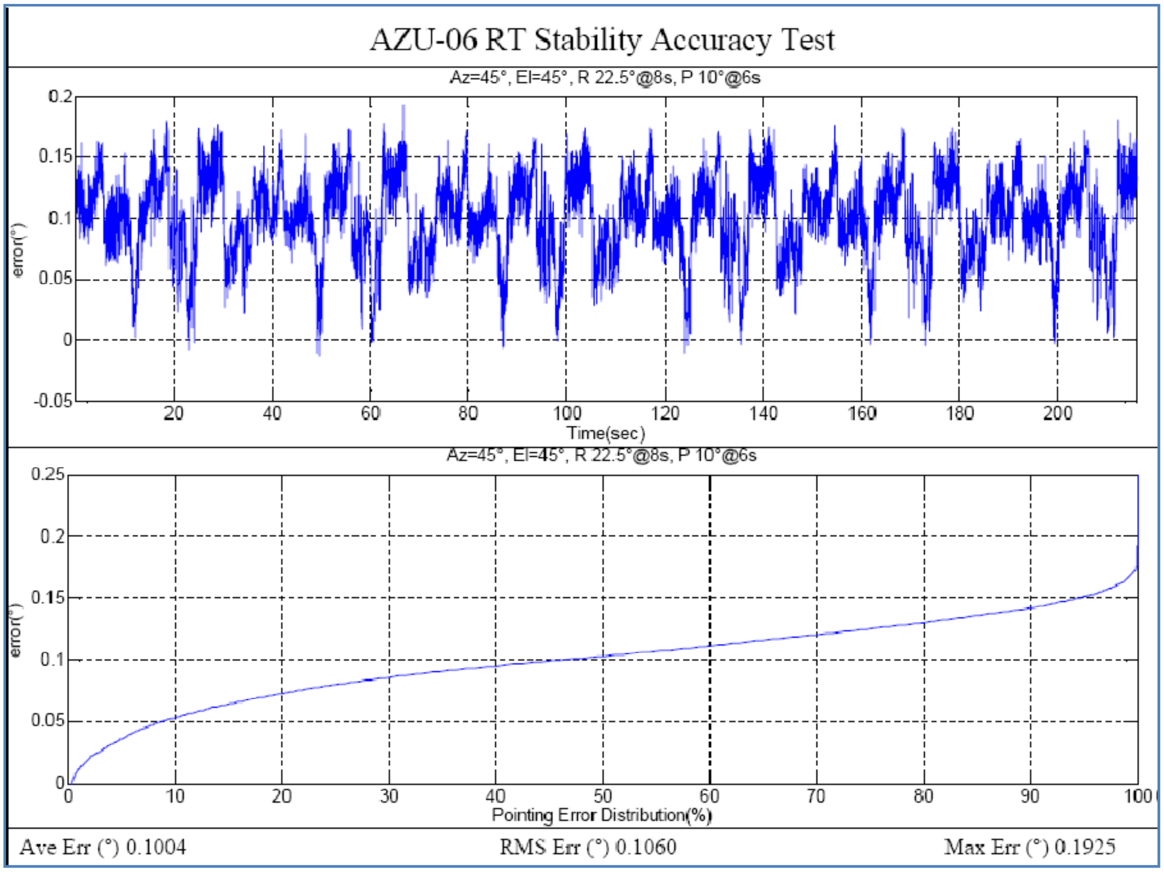

Figure 1. AZU-06 Pointing Accuracy

At all times, the above-deck pedestal controller compares a running average of the measured azimuth and elevation to the desired azimuth and elevation positions. If the results exceed the 0.5° off-axis threshold, then transmissions will cease within 100 milliseconds and will not resume until the pointing accuracy is within ±0.2° of the target satellite.

Auto Shut-off Mechanism of the AZIMUTH AZU-06 Antenna

Using a 32-bit Digital Signal Processor (DSP) and a 150MHz clock, every 5ms the AZIMUTH AZU-06 Antenna compares the instantaneous pointing vector to the long term average. Additional delays occur at the Pedestal Control Unit (PCU), IF cable, and Antenna Control Unit (ACU) of 10 milliseconds, 5 milliseconds, and 10 milliseconds respectively. The satellite modem adds another 10 milliseconds of delay. Therefore, the worst case response time for the system to turn off transmissions after the AZIMUTH AZU-06 Antenna detects an off-axis deviation of more than 0.5 degrees is 40 milliseconds as summarized below:

Polling time:	05 ms
PCU processing time:	10 ms
Cable propagation delay:	05 ms
ACU processing time:	10 ms
Satellite modem processing time:	10 ms
Total response time:	40 ms

The following diagram illustrates the concept.

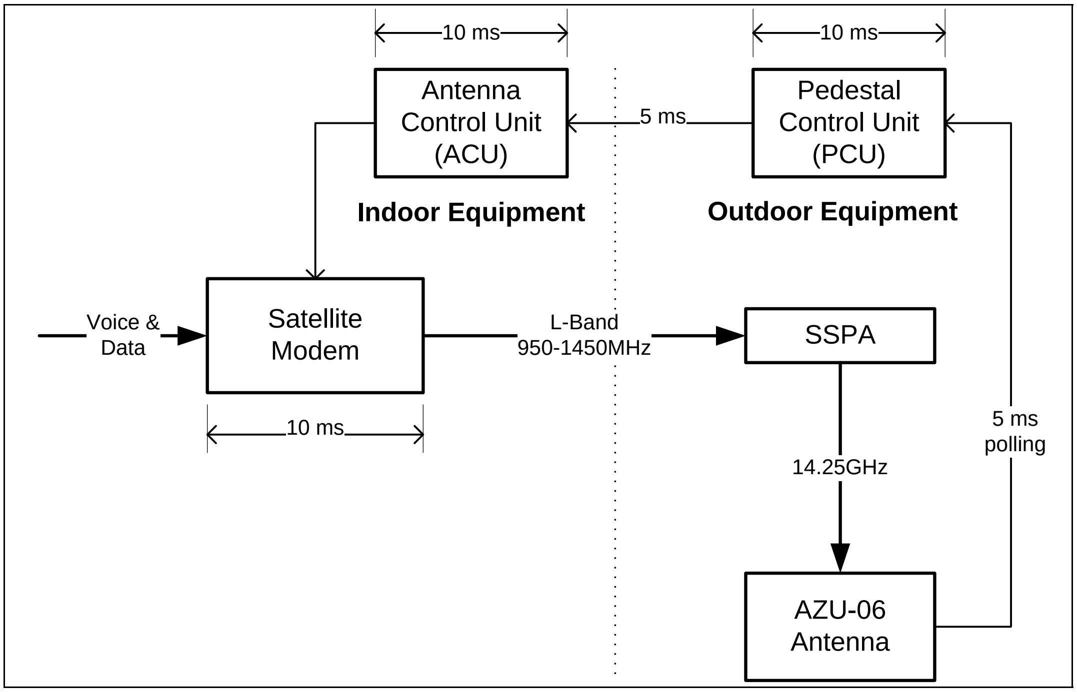

Figure 2. Auto Shut-off Mechanism

§25.222 (a)(8) U.S. CONTACT INFORMATION

"There shall be a point of contact in the United States, with phone number and address included with the application, available 24 hours a day, seven days of week, with authority and ability to cease all emissions from the ESVs, either directly or through the facilities of a U.S. Hub or a Hub located in another country with which the U.S. has a bilateral agreement that enables such cessation of emissions." 47 C.F.R §25.222(a)(8).

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(337) 332-4347 phone

DTS personnel, either via a network port or an out-of-band management system, have the authority and capability to remotely access equipment on the ESV to terminate emissions in case of suspected interference.

§25.222 (a)(9) ANTENNA RADIATION GUIDELINES

"ESVs that exceed the radiation guidelines of §1.1310 of this chapter, Radiofrequency radiation exposure limits, must provide, with their environmental assessment, a plan for mitigation exposure to the extent required to meet those guidelines." 47 C.F.R. §25.222 (c)(9).

See analysis in Appendix C.

§25.222 (a)(10)   ESV GEOGRAPHIC AREA OF OPERATION

"There shall be an exhibit included with the application describing the geographic area(s) in which the ESVs will operate." 47 C.F.R §25.222(a)(10).

The geographic area where the ESVs will operate is in US channels and waterways, the Gulf of Mexico, Caribbean Sea, Atlantic Ocean, and Pacific Ocean.

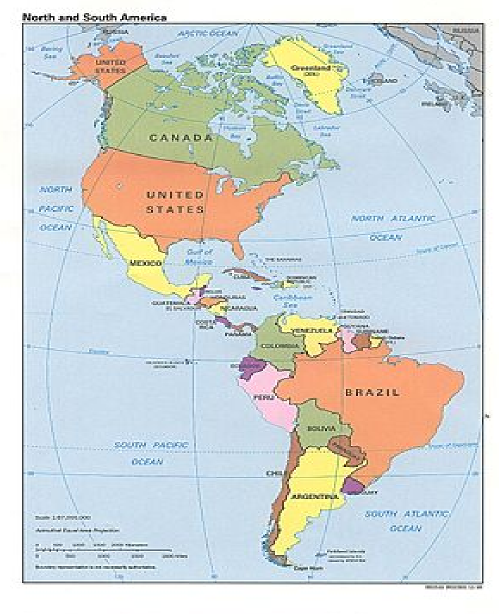


Figure 3. US channels and waterways, the Gulf of Mexico, Caribbean Sea, Atlantic Ocean, and Pacific Ocean

§25.222 (b)(1)   EIRP DENSITY CHARTS

Spectral Density Requirement

"Applications for ESV operation in the 14.0 – 14.5 GHz (Earth-to-space) to geostationary satellites in the fixed-satellite service must include, in addition to the particulars of operation identified in Form 312 and associated Schedule B, the following data for each earth station antenna type:

"A series of e.i.r.p. density charts or tables, calculated for a production earth station antenna, based on measurements taken on a calibrated antenna range at 14.25 GHz, with the off-axis e.i.r.p. envelope set forth in paragraphs (a)(1) through (a)(4) of this section superimposed as follows:

- *Showing off-axis co-polarized e.i.r.p spectral density in the AZIMUTH AZU-06 place, for off-axis angles from minus 10° to plus 10° and from minus 180° to plus180°.*
- *Showing off-axis co-polarized e.i.r.p. spectral density in the elevation plane, at off-axis angles from 0° to plus 30°.*
- *Showing off-axis cross-polarized e.i.r.p spectral density in the AZIMUTH AZU-06 plane, at off-axis angles from minus 10° to plus 10°.*
- *Showing of off-axis cross-polarized e.i.r.p. spectral density in the elevation plane, at off-axis angles from minus 10° to plus 10°."*

47 C.F.R. §25.222 (b)(1)(i-iv).

Spectral Density Envelopes

The spectral density envelopes specified in §25.222(a)(1) through (a)(4) are as follows:[2]

§25.222(a)(1) – Copole Azimuth

•	*15 – 25log(θ)*	*dBW / 4KHz for*	*1.25° ≤ θ ≤ 7.0°*
•	*-6*	*dBW / 4KHz for*	*7.0° ≤ θ ≤ 9.2°*
•	*18 – 25log(θ)*	*dBW / 4KHz for*	*9.2° ≤ θ ≤ 48°*
•	*-24*	*dBW / 4KHz for*	*48° ≤ θ ≤ 180°*

§25.222(a)(2) – Copole in other directions

•	*18 – 25log(θ)*	*dBW / 4KHz for*	*1.25° ≤ θ ≤ 48°*
•	*-24*	*dBW / 4KHz for*	*48° ≤ θ ≤ 180°*

§25.222(a)(3) – Sidelobes

Values of θ > 7° in (a)(1) may be exceeded by no more than 10% of the sidelobes, provided no individual sidelobe exceeds the criteria given by no more than 3dB.

§25.222(a)(4) – Crosspole Azimuth

•	*5 – 25log(θ)*	*dBW / 4KHz for*	*1.8° ≤ θ ≤ 7°*
•	*-16*	*dBW / 4KHz for*	*7° ≤ θ ≤ 9.2°*

Spectral Density Charts

Azimuth Unlimited, LLC produced the spectral density charts shown below. The plots show that the AZIMUTH AZU-06 Antenna complies with this section when the power density to the antenna feed is kept below -21.4dBW/4KHz.

[2] The actual formula in the statute includes a log(N) term which is subtracted from the spectral density. Since in this case, the system is TDMA and N=1 for TDMA, the log(1) terms goes to zero.

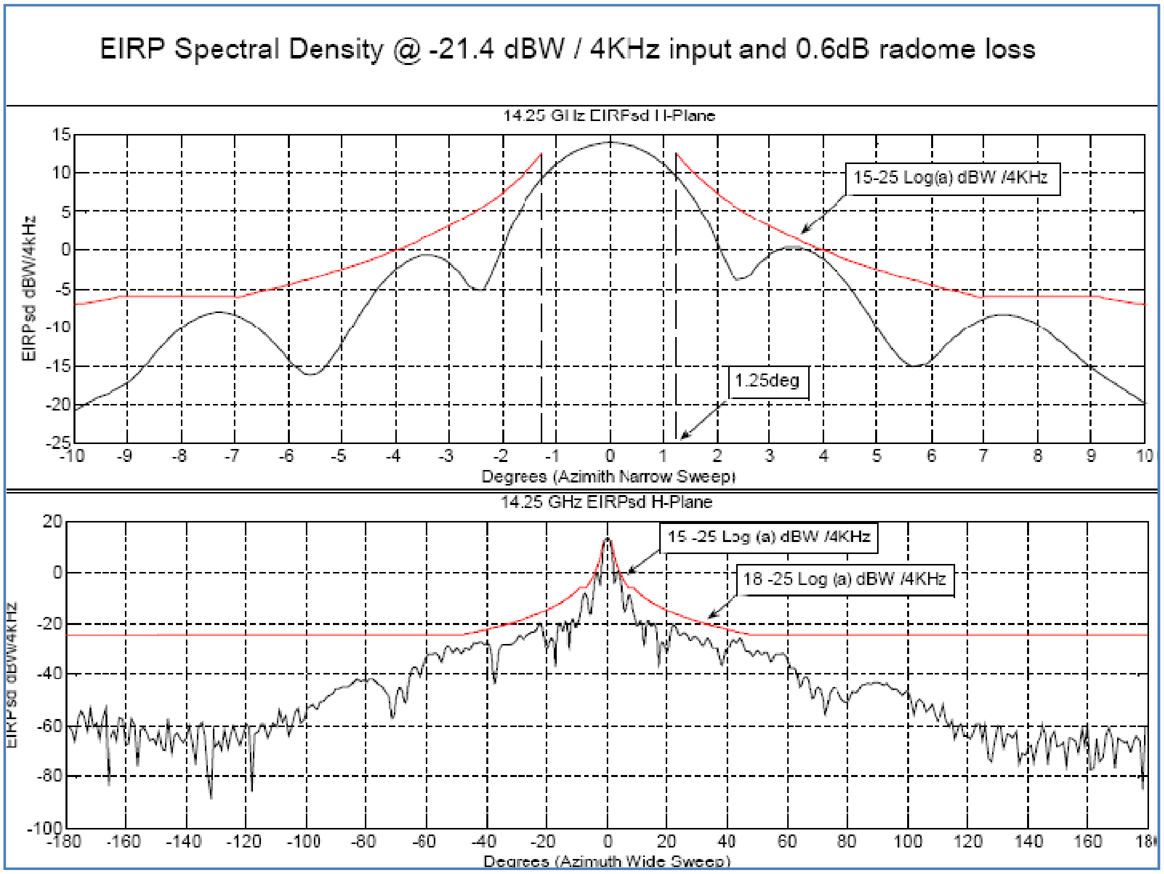


Figure 4. Copole Azimuth per §25.222(a)(1) at SD -21.4dBW/4KHz

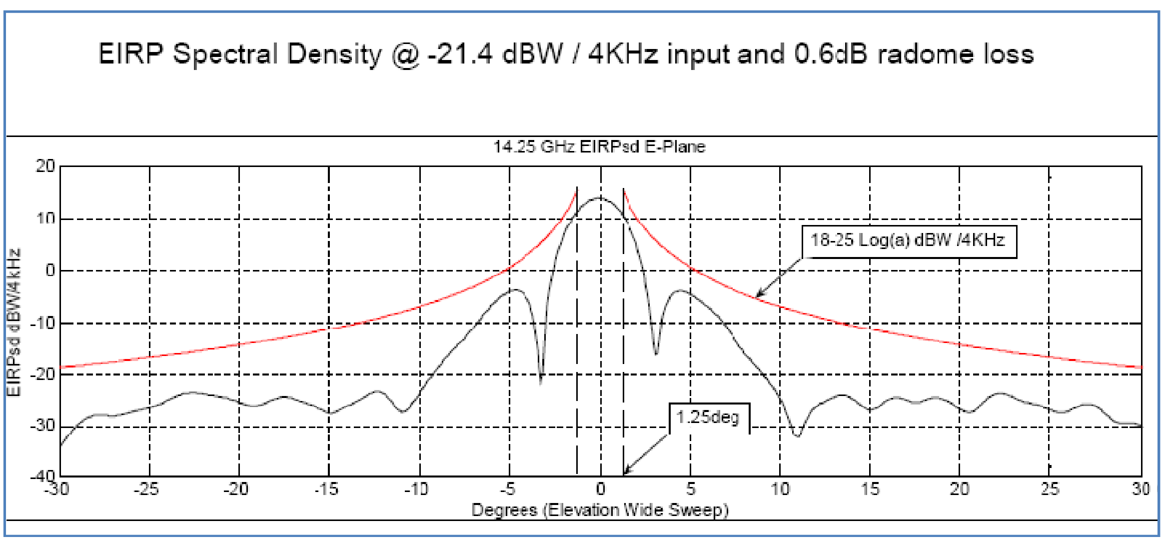


Figure 5. Copole Elevation per §25.222(a)(2) at SD -21.4dBW/4KHz

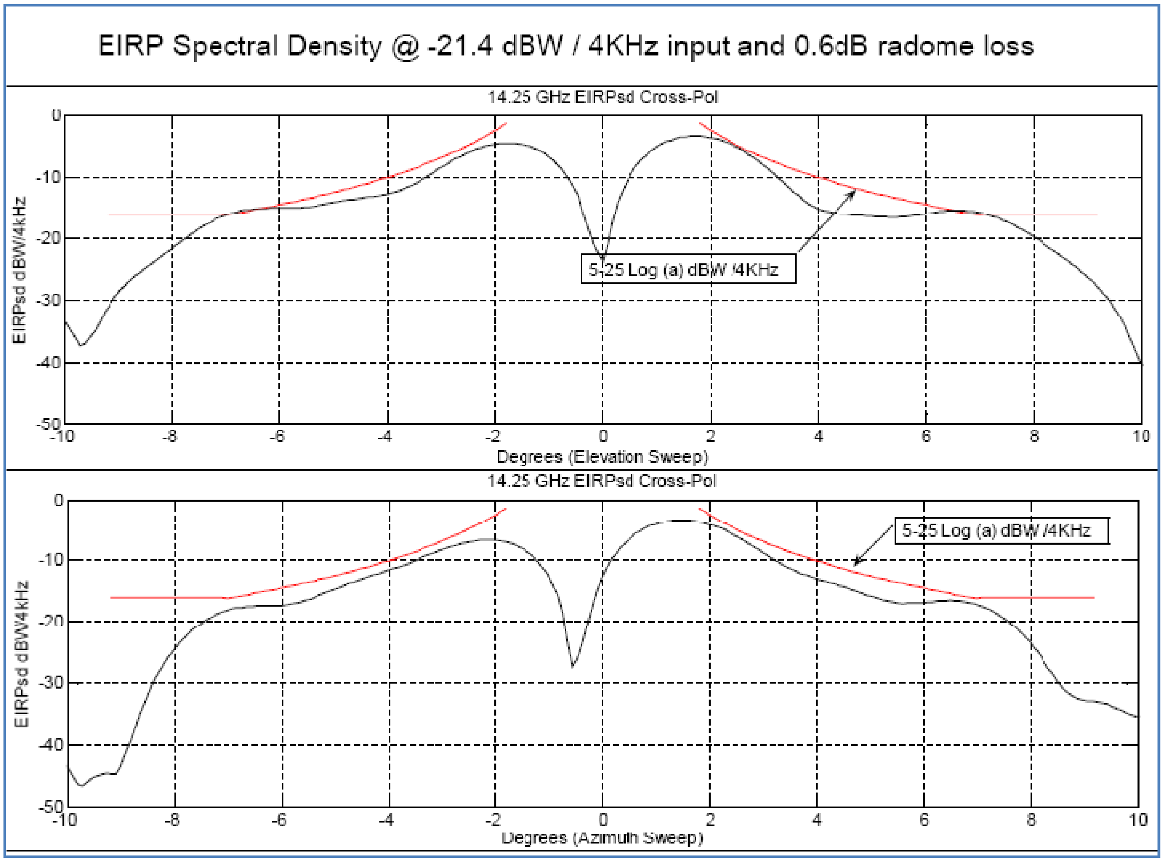


Figure 6. Crosspole Elevation and Azimuth per §25.222(a)(4) at SD -21.4dBW/4KHz

§ 25.222 (c)(1) VESSEL TRACKING

"For each ESV transmitter a record of the ship location (i.e. latitude/longitude), transmit frequency, channel bandwidth and satellite used shall be time annotated and maintained for a period of not less than 1 year. Records will be recorded at time intervals <u>no greater than every 20 minutes</u> while the ESV is transmitting. The ESV operator will make this data available upon request to a coordinator, fixed system operator, fixed-satellite system operator, NTIA, or the Commission within 24 hours of the request." 47 C.F.R. §25.222 (c)(1).

<u>Functionality of Vessel Tracking System</u>

DTS has designed a system to record the vessel's location, transmit frequency, channel bandwidth and satellite. The system records this information every 20 minutes. This data will be stored locally and will be uploaded to DTS's Network Management System (NMS) on a regular basis. DTS can make this data available within 24 hours of a request by a coordinator, fixed system operator, fixed-satellite system operator, NTIA, or the Commission.

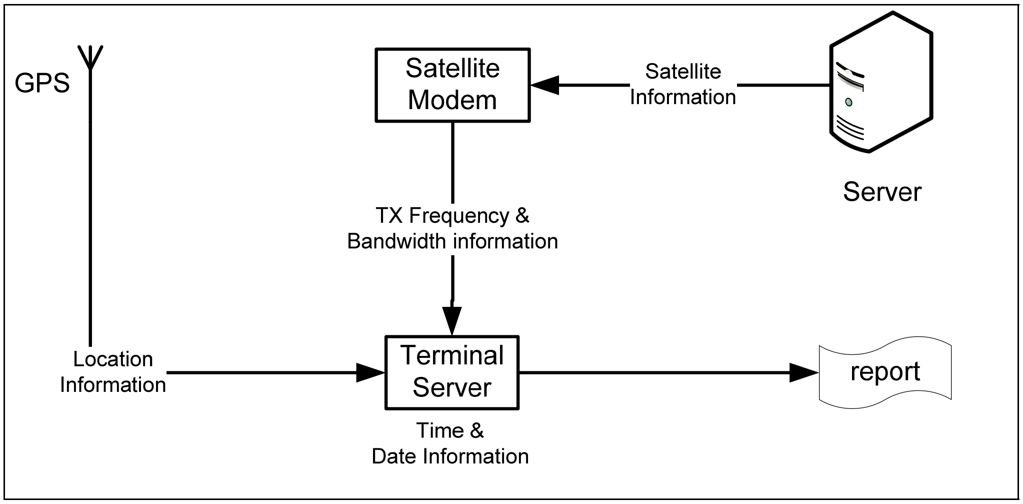


Figure 7. Vessel Tracking Network Configuration

§25.222 (c)(2) VESSELS OF FOREIGN REGISTRY

"ESV operators communicating with vessels of foreign registry must maintain detailed information on each vessel's country of registry and a point of contact for the relevant administration responsible for licensing ESVs." 47 C.F.R. §25.222 (c)(2).

In the event DTS must operate foreign-registered ESVs, it will maintain detailed information on each vessel as well as a point of contact for the relevant administration responsible for licensing the ESV.

§25.222 (c)(3) U.S. CONTROL OF ESV HUB EARTH STATION

"ESV operators shall control all ESVs by a Hub earth station located in the United States, except that an ESV on U.S.-registered vessels may operate under control of a Hub earth station location outside the United States provided the ESV operator maintains a point of contact within the United States that will have the capability and authority to cause an ESV on a U.S.-registered vessel to cease transmitting if necessary." 47 C.F.R. §25.222 (c)(3).

The ESVs operated by DTS will be controlled by the earth station listed below:

Callsign	Diameter	Location	Antenna ID
KA399	9.0m	Mt. Jackson*	9.0M

*1305 Industrial Park Road, Mount Jackson, Shenandoah, VA 22842

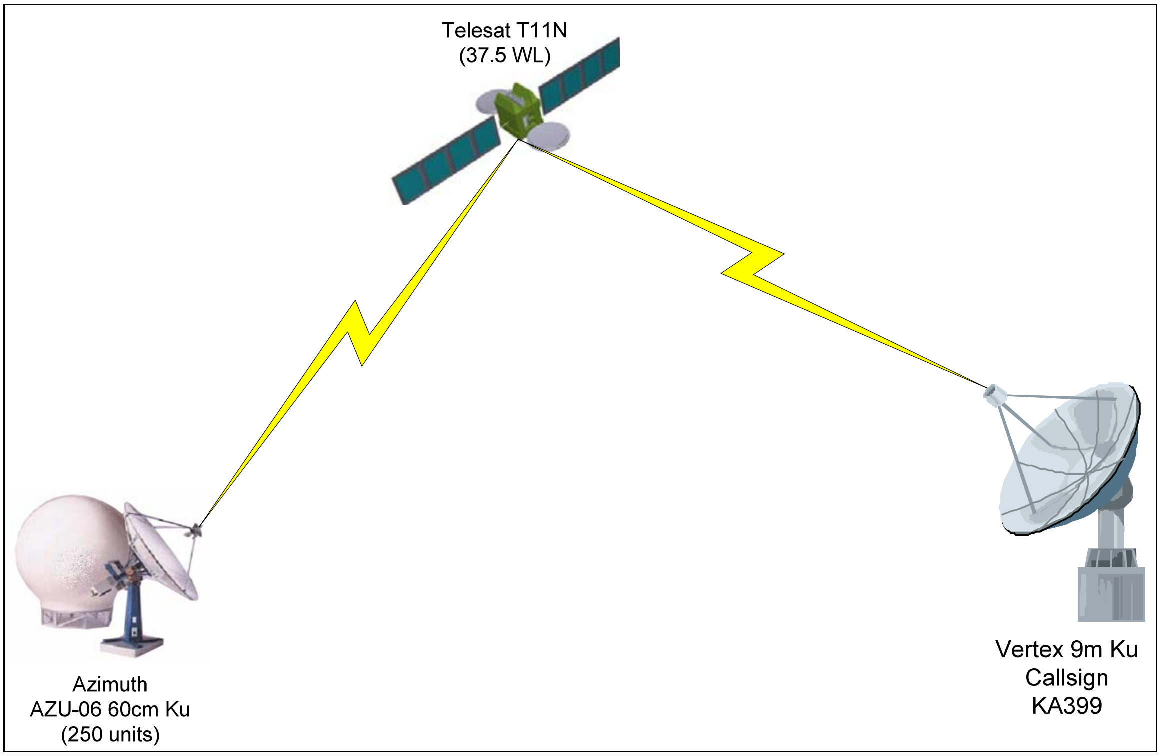


Figure 8. Network Diagram

§25.222 (d) FREQUENCY COORDINATION

"Operations of ESVs in the 14.0-14.2 GHz (Earth-to-space) frequency band within 125 Km of the NASA TDRSS facilities in Guam … or White Sands, New Mexico… are subject to coordination through the National Telecommunications and Information Administration (NTIA) Interdependent Radio Advisory Committee (IRAC). [U]pon public notice from the Commission, all Ku-band ESV operators must cease operations…." 47 C.F.R. §25.222 (d).

The ESVs operated by DTS will not operate within 125 Km of the NASA TDRSS facilities in Guam or White Sands, New Mexico.

§25.222 (e) FREQUENCY COORDINATION

"Operations of ESVs in the 14.47-14.5 GHz (Earth-to-space) frequency band within a) 45Km of the radio observatory on St. Croix, Virgin Islands…; b) 125 Km of the radio observatory on Mauna Kea, Hawaii …; and c) 90 Km of the Arecibo Observatory on Puerto Rico … are subject to coordination through the National Telecommunications and Information Administration (NTIA) Interdepartment Radio Advisory Committee (IRAC)." 47 C.F.R. §25.222 (e).

The ESVs operated by DTS will not operate within 48 Km of the radio observatory on St. Croix; within 125 Km of the radio observatory on Mauna Kea; or within 90 Km of the Arecibo observatory on Puerto Rico. ESVs operated by DTS will operate in the Gulf of Mexico, US channels and waterways, the Caribbean Sea, Atlantic Ocean and Pacific Ocean as described above.

§25.222 (f) ACCEPTANCE OF INTERFERENCE

"In the 10.95-11.2 GHz (space-to-Earth) and 11.45-11.7 GHz (space-to-Earth) frequency bands ESVs shall not claim protection from interference from any authorized terrestrial stations to which frequencies are either already assigned, or may be assigned in the future." 47 C.F.R. §25.222 (f).

In the 10.95-11.2 GHz and 11.45-11.7GHz bands, DTS will not claim protection from interference from any authorized terrestrial station to which frequencies are either already assigned, or may be assigned in the future.

ESV Order ¶102 MINIMUM ELEVATION ANGLE

"Earth station antennas shall not normally be authorized for transmission at angles less than 5° measured from the horizontal plane to the direction of maximum radiation. 47 C.F.R. § 25.205

The ESVs will not operate with elevation angles less than 5 degrees.

ESV Order ¶105 ALSAT AUTHORITY

"We find significant support in the record for granting Ku-band ESVs ALSAT authority." [3]

DTS requests that ALSAT authority be granted with this application. In addition, DTS requests authority to utilize various international satellites including SATMEX V (116.9ºW) and STAMEX 6 (113.0W) which are international satellites listed in the *Permitted Space Station List*.[4]

ESV Order ¶107 AFFIDAVITS FROM ADJACENT SATELLITES

"In the ESV NPRM, the Commission proposed that Ku-band ESV network operators be required to prove, via affidavit, that its operations have been successfully coordinated with adjacent satellite licenses that are two degrees removed from the satellite used by the ESV operator. We find that requiring submission of an affidavit stating that this coordination has taken place is unnecessary given operational conditions and off-axis e.i.r.p. limits we require of Ku-band ESV systems."

DTS provides no affidavits from adjacent satellite operators as this requirement was found unnecessary by the Commission in the ESV Order.

[3] *The ESV Order* ¶ 105.

[4] *In the Matter of Satelites Mexicanos, S.A. de C.V. Petition for Declaratory Ruling*, DA 00-1793, File No. SAT-PDR-19991214-00131 (Adopted Actober 2, 2000, Released October 3, 2000).

APPENDIX A – USE OF NON-U.S. SATELLITES

DTS specifies, pursuant to § 25.137(a) of the Commission's Rules, that the only non-U.S. licensed satellites to be accessed by the earth station proposed in the instant application are those included on the FCC's Permitted List and eligible for ALSAT designation.

APPENDIX B – FAA NOTIFICATION

Pursuant to 47 C.F.R. § 17.14 (b) of the Regulations, Federal Aviation Administration (FAA) notification is not required because all the antenna structures in this application will be less than 6.1m in height.

APPENDIX C – RADIATION HAZARD STUDY – AZIMUTH AZU-06 ANTENNA

The study in this section analyzes the potential RF human exposure levels caused by the Electro Magnetic (EM) fields of an Azimuth AZU-06 antenna operating with the maximum power at the flange shown below. The mathematical analysis performed below complies with the methods described in the FCC Office of Engineering and Technology (OET) Bulletin No. 65 (1985 rev. 1997) R&O 96-326.[5]

Maximum Permissible Exposure

There are two separate levels of exposure limits. The first applies to persons in the general population who are in an uncontrolled environment. The second applies to trained personnel in a controlled environment. According to 47 C.F.R. § 1.1310, the Maximum Permissible Exposure (MPE) limits for frequencies above 1.5 GHz are as follows:

- General Population / Uncontrolled Exposure 1.0 mW/cm^2
- Occupational / Controlled Exposure 5.0 mW/cm^2

The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the feed and the antenna surface
5. The main reflector region
6. The region between the antenna edge and the ground

Input Parameters

The following input parameters were used in the calculations:

Parameter	Value	Unit	Symbol
Antenna Diameter	0.60	m	*D*
Antenna Transmit Gain	37.2	dBi	*G*
Transmit Frequency	14250	MHz	*f*
Antenna Feed Flange Diam.	7.24	cm	*d*
Power Input to the Antenna	3.5	Watts	*P*

Calculated Parameters

The following values were calculated using the above input parameters and the corresponding formula:

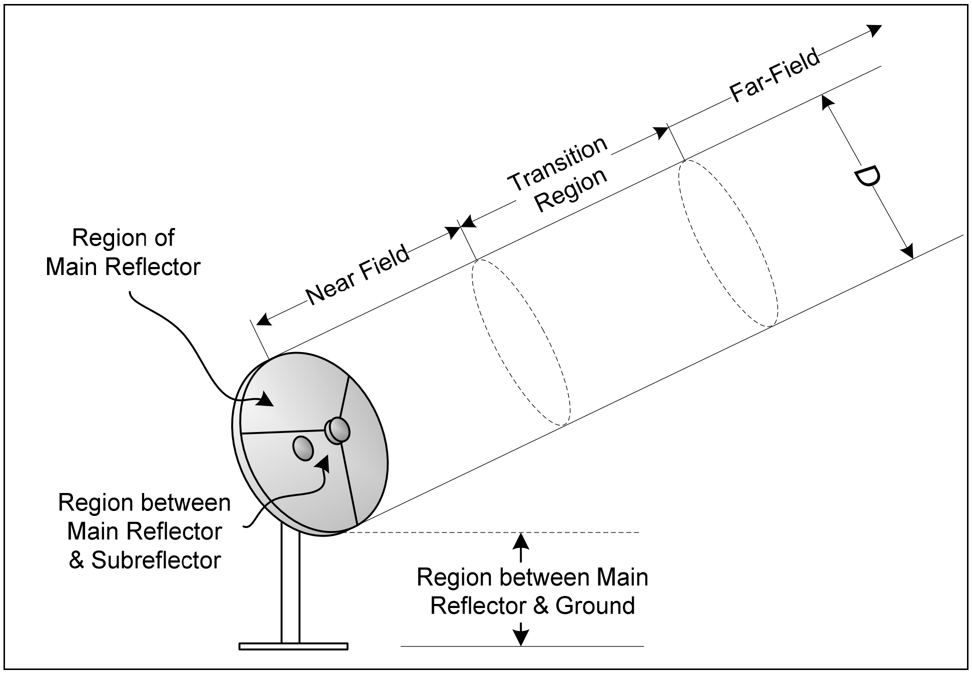
Parameter	Value	Unit	Symbol	Formula
Antenna Surface Area	0.28	m^2	*A*	$\pi D^2/4$
Area of Antenna Flange	41.17	cm^2	*a*	$\pi d^2/4$
Antenna Efficiency	0.65		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor	5248.1	*g*	$10^{G/10}$	
Wavelength	0.0211	m	λ	300/ *f*

Behavior of EM Fields as a Function of Distance

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region.

[5] *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields*, OET Bulletin 65 (Edition 97-01), Supplement B, FCC Office of Engineering & Technology, November 1997.

Of interest also are the region between the antenna main reflector and the subreflector, the region of the main reflector area and the region between the main reflector and ground.



EF Fields as a Function of Distance

For parabolic aperture antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

Near-Field Distance	$R_{nf} = D^2/(4\lambda)$	= 4.275 m
Distance to Far-Field	$R_{ff} = 0.60D^2/(\lambda)$	= 10.260 m
Distance of Transition Region	$R_t = R_{nf}$	= 4.275 m

The distance in the transition region is between the near and far fields. Thus, $R_{nf} \leq R_t \leq R_{ff}$. However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

Power Flux Density Calculations

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, *D*, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

Power Density in the Near-Field	S_{nf}	$= 16.0\ \eta\ P/(\pi D^2)$	= 4.275 mW/cm^2
Power Density in the Far-Field	S_{ff}	$= GP/(4\pi\ R_{ff}^2)$	= 1.389 mW/cm^2
Power Density in the Transition Region	S_t	$= S_{nf}\ R_{nf}\ /(R_t)$	= 4.275 mW/cm^2

The region between the main reflector and the subreflector is confined to within a conical shape defined by the feed assembly. The most common feed assemblies are waveguide flanges. This energy is determined as follows:

Power Density at the Feed Flange	S_{fa}	$= 4P / a$	= 340.064 mW/cm^2

The power density in the main reflector is determined similarly to the power density at the feed flange; except that the area of the reflector is used.

Power Density at Main Reflector $S_{surface}$ $= 4P / A$ $= 4.951$ mW/cm²

The power density between the reflector and ground, assuming uniform illumination of the reflector surface, is calculated as follows:

Power Density b/w Reflector and Gnd S_g $= P / A$ $= 1.238$ mW/cm²

Summary of Calculations

Table 1 summarizes the calculated power flux density values for each region. In a controlled environment, only the region between the main reflector and feed exceeds FCC limitations. It is important to note that this antenna will only be accessed by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in this area. The antenna operates in an enclosed radome that is locked during normal operation.

Power Densities	(mW/cm²)	Controlled Environment (5mW/cm²)
Far Field Calculation	1.389	Satisfies FCC MPE
Near Field Calculation	3.242	Satisfies FCC MPE
Transition Region	3.242	Satisfies FCC MPE
Region b/w Main Reflector and Feed	340.064	Exceeds limitations
Main Reflector Region	4.951	Satisfies FCC MPE
Region b/w Main Reflector & Ground	1.238	Satisfies FCC MPE

Table 1. Power Flux Density for Each Region

In conclusion, the results show that the antenna, in a controlled environment, and under the proper mitigation procedures, meets the guidelines specified in § 1.1310 of the Regulations.

APPENDIX D – DECLARATION OF DTS

I, Mike Guidroz, President of Data Technology Solutions, LLC, certify that the engineering calculations described in this report are true and correct and are satisfactory in light of the regulations specified in 47 C.F.R. 25.222.

/s/*Mike Guidroz*
Mike Guidroz, President

9-29-10
Date