

**Exhibit For
Denali 20020, LLC
Vernon, New Jersey
Andrew 7.6 Meter Earth Station**

**Compliance with FCC Report & Order (FCC96-377) for the 13.75 - 14.0 GHz Band
Analysis and Calculations**

1. Background

This Exhibit is presented to demonstrate the extent to which the Denali 20020, LLC satellite earth station in Vernon, New Jersey is in compliance with FCC REPORT & ORDER 96-377. The potential interference from the earth station to US Navy shipboard radiolocation operations (RADAR) and the NASA space research activities in the 13.75 - 14.0 GHz Band is addressed in this exhibit. The parameters for the earth station are:

Table 1. Earth Station Characteristics

- Coordinates (NAD83): 41° 12' 4.1" N, 74° 31' 37.5" W
- Satellite Location for Earth Station: 61.0° W
- Frequency Band: 13.75-14.0 GHz for uplink
- Polarizations: Linear
- Emissions: 36M0G7W
- Modulation: Digital
- Maximum Aggregate Uplink EIRP: 74.6 dBW for the 36 MHz Carriers
- Transmit Antenna Characteristics
 - Antenna Size: 7.6 meters in Diameter
 - Antenna Type/Model: Andrew
 - Gain: 59.4 dBi
- RF power into Antenna Flange:
 - 36 MHz
 - 15.2 dBW
 - or -24.4 dBW/4 kHz (Maximum)
- Minimum Elevation Angle:
 - Vernon, NJ
 - 40.4° @ 159.9° Az.
- Side Lobe Antenna Gain: $32 - 25 \cdot \log(\theta)$

Because the above uplink spectrum is shared with the Federal Government, coordination in this band requires resolution data pertaining to potential interference between the earth station and both Navy Department and NASA systems. Potential interference from the earth station could impact with the Navy and/or NASA systems in two areas. These areas are noted in FCC Report and Order 96-377 dated September 1996, and consist of (1) Radiolocation and radio navigation, (2) Data Relay Satellites.

Summary of Coordination Issues:

- 1) Potential Impact to Government Radiolocation (Shipboard Radar)
- 2) Potential Impact to NASA Data Relay Satellite Systems (TDRSS)

2. Potential Impact to Government Radiolocation (Shipboard Radar)

Radiolocation operations (RADAR) may occur anywhere in the 13.4 - 14 GHz frequency band aboard ocean going United States Navy ships. The Federal Communication Commission (FCC) order 96-377 allocates the top 250 MHz of this 600 MHz band to the Fixed Satellite Service (FSS) on a co-primary basis with the radiolocation operations and provides for an interference protection level of -167 dBW/m²/4 kHz.

The closest distance to the shoreline from the Vernon earth station is approximately 93.8 km Southeast. The calculation of the power spectral density at this distance is given by:

36.0 MHz

1. Clear Sky EIRP (dBW): 74.6
2. Carrier Bandwidth: 36 MHz
3. PD at antenna Input: -24.4 (dBW/4 kHz)
4. Transmit Antenna Gain: 59.4 dBi
5. Antenna Gain Horizon: FCC Reference Pattern
6. Antenna Elevation Angle: 40.4°

The proposed earth station will radiate interference toward the shoreline according to its off-axis side-lobe performance. A conservative analysis, using FCC standard reference pattern, results in off-axis antenna gains of -9.0 dBi toward the coastline.

The signal density at the shoreline, through free space is:

36 MHz Carriers

$$\begin{aligned} \text{PFD} &= \text{Antenna Feed Power density (dBW/4 kHz)} + \text{Antenna Off-Axis Gain (dBi)} - \text{Spread Loss (dBW-m}^2\text{)}. \\ &= -24.4 \text{ dBW/4 kHz} + (-9.0) \text{ dBi} - 10 \cdot \log[4\pi \cdot (93800\text{m})^2] \\ &= -143.8 \text{ dBW/m}^2\text{/4 kHz} + \text{Additional Path Losses } (\sim 74.8 \text{ dB}) \\ &= -218.6 \text{ dBW/m}^2\text{/4 kHz} \end{aligned}$$

Our calculations identified additional path losses of approximately 74.8 dB including absorption loss and earth diffraction loss for the actual path profiles from the earth station to the nearest shoreline.

The worst case calculated PFD when considering all carriers, including additional path losses to the closest shoreline location is $-218.6 \text{ dBW/m}^2/4 \text{ kHz}$. The proposed carrier is a minimum of 51.6 dB below the $-167 \text{ dBW/m}^2/4 \text{ kHz}$ interference criteria of R&O 96-377. Therefore, there should be no interference to the US Navy RADAR from the Vernon earth station due to the distance and the terrain blockage between the site and the shore.

3. Potential Impact to NASA's Data Relay Satellite System (TDRSS)

The geographic location of the Denali 20020 LLC earth station in Vernon, New Jersey is outside the 390 km radius coordination contour surrounding NASA's White Sands, New Mexico ground station complex. Therefore, the TDRSS space-to-earth link will not be impacted by the Denali 20020, LLC earth station in Vernon, New Jersey.

The TDRSS space-to-space link in the 13.772 to 13.778 GHz band is assumed to be protected if an earth station produces an EIRP less than 71 dBW/6 MHz in this band. The 7.6 meter earth station antenna will have an EIRP less than 71 dBW/6 MHz for the 36 MHz carriers in this band. The EIRP for the 36 MHz carriers is 74.6 dBW. The equivalent EIRP per 6 MHz segment will be 68.6 dBW/6 MHz. Therefore, there should not be interference to the TDRSS space-to-space link for the 36 MHz carriers.

4. Coordination Issue Result Summary and Conclusions

The results of the analysis and calculations performed in this exhibit indicate that compatible operations between the earth station at the Vernon facility and the US Navy and NASA systems space-to-earth link and NASA systems space-to-space link (13772.0 to 13778.0 MHz) will be permitted for the 1 MHz through 36 MHz carriers.

**Exhibit For
Denali 20020, LLC
Vernon, New Jersey
Vertex 9 Meter Earth Station**

**Compliance with FCC Report & Order (FCC96-377) for the 13.75 - 14.0 GHz Band
Analysis and Calculations**

1. Background

This Exhibit is presented to demonstrate the extent to which the Denali 20020, LLC satellite earth station in Vernon, New Jersey is in compliance with FCC REPORT & ORDER 96-377. The potential interference from the earth station to US Navy shipboard radiolocation operations (RADAR) and the NASA space research activities in the 13.75 - 14.0 GHz Band is addressed in this exhibit. The parameters for the earth station are:

Table 1. Earth Station Characteristics

- Coordinates (NAD83): 41° 12' 4.1" N, 74° 31' 37.5" W
- Satellite Location for Earth Station: 61.0° W
- Frequency Band: 13.75-14.0 GHz for uplink
- Polarizations: Linear
- Emissions: 36M0G7W
- Modulation: Digital
- Maximum Aggregate Uplink EIRP: 74.6 dBW for the 36 MHz Carriers
- Transmit Antenna Characteristics
 - Antenna Size: 9 meters in Diameter
 - Antenna Type/Model: Vertex
 - Gain: 60.1 dBi
- RF power into Antenna Flange:
 - 36 MHz
 - 14.5 dBW
 - or -25.1 dBW/4 kHz (Maximum)
- Minimum Elevation Angle:
 - Vernon, NJ
 - 40.4° @ 159.9° Az.
- Side Lobe Antenna Gain: $32 - 25 * \log(\theta)$

Because the above uplink spectrum is shared with the Federal Government, coordination in this band requires resolution data pertaining to potential interference between the earth station and both Navy Department and NASA systems. Potential interference from the earth station could impact with the Navy and/or NASA systems in two areas. These areas are noted in FCC Report and Order 96-377 dated September 1996, and consist of (1) Radiolocation and radio navigation, (2) Data Relay Satellites.

Summary of Coordination Issues:

- 1) Potential Impact to Government Radiolocation (Shipboard Radar)
- 2) Potential Impact to NASA Data Relay Satellite Systems (TDRSS)

2. Potential Impact to Government Radiolocation (Shipboard Radar)

Radiolocation operations (RADAR) may occur anywhere in the 13.4 - 14 GHz frequency band aboard ocean going United States Navy ships. The Federal Communication Commission (FCC) order 96-377 allocates the top 250 MHz of this 600 MHz band to the Fixed Satellite Service (FSS) on a co-primary basis with the radiolocation operations and provides for an interference protection level of -167 dBW/m²/4 kHz.

The closest distance to the shoreline from the Vernon earth station is approximately 93.8 km Southeast. The calculation of the power spectral density at this distance is given by:

36.0 MHz

7. Clear Sky EIRP (dBW): 74.6
8. Carrier Bandwidth: 36 MHz
9. PD at antenna Input: -25.1 (dBW/4 kHz)
10. Transmit Antenna Gain: 60.1 dBi
11. Antenna Gain Horizon: FCC Reference Pattern
12. Antenna Elevation Angle: 40.4°

The proposed earth station will radiate interference toward the shoreline according to its off-axis side-lobe performance. A conservative analysis, using FCC standard reference pattern, results in off-axis antenna gains of -9.0 dBi toward the coastline.

The signal density at the shoreline, through free space is:

36 MHz Carriers

$$\begin{aligned} \text{PFD} &= \text{Antenna Feed Power density (dBW/4 kHz)} + \text{Antenna Off-Axis Gain (dBi)} - \text{Spread Loss (dBW-m}^2\text{)}. \\ &= -25.1 \text{ dBW/4 kHz} + (-9.0) \text{ dBi} - 10 \cdot \log[4\pi \cdot (93800\text{m})^2] \\ &= -144.5 \text{ dBW/m}^2\text{/4 kHz} + \text{Additional Path Losses } (\sim 74.8 \text{ dB}) \\ &= -219.3 \text{ dBW/m}^2\text{/4 kHz} \end{aligned}$$

Our calculations identified additional path losses of approximately 74.8 dB including absorption loss and earth diffraction loss for the actual path profiles from the earth station to the nearest shoreline.

The worst case calculated PFD when considering all carriers, including additional path losses to the closest shoreline location is $-219.3 \text{ dBW/m}^2/4 \text{ kHz}$. The proposed carrier is a minimum of 52.3 dB below the $-167 \text{ dBW/m}^2/4 \text{ kHz}$ interference criteria of R&O 96-377. Therefore, there should be no interference to the US Navy RADAR from the Vernon earth station due to the distance and the terrain blockage between the site and the shore.

3. Potential Impact to NASA's Data Relay Satellite System (TDRSS)

The geographic location of the Denali 20020 LLC earth station in Vernon, New Jersey is outside the 390 km radius coordination contour surrounding NASA's White Sands, New Mexico ground station complex. Therefore, the TDRSS space-to-earth link will not be impacted by the Denali 20020, LLC earth station in Vernon, New Jersey.

The TDRSS space-to-space link in the 13.772 to 13.778 GHz band is assumed to be protected if an earth station produces an EIRP less than 71 dBW/6 MHz in this band. The 9 meter earth station antenna will have an EIRP less than 71 dBW/6 MHz for the 36 MHz carriers in this band. The EIRP for the 36 MHz carriers is 74.6 dBW. The equivalent EIRP per 6 MHz segment will be 68.6 dBW/6 MHz. Therefore, there should not be interference to the TDRSS space-to-space link for the 36 MHz carriers.

4. Coordination Issue Result Summary and Conclusions

The results of the analysis and calculations performed in this exhibit indicate that compatible operations between the earth station at the Vernon facility and the US Navy and NASA systems space-to-earth link and NASA systems space-to-space link (13772.0 to 13778.0 MHz) will be permitted for the 1 MHz through 36 MHz carriers.