Newcom International, Inc.
Miami, Florida
Andrew Corporation 4.5 Meter Earth Station
Call Sign: E050018

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 Newcom International, Inc. satellite earth station in Miami, Florida 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 as follows:

Table 1. Earth Station Characteristics

- Coordinates (NAD83): 25° 54' 59.3" North, 80° 13' 29.2" West
- Satellite Location for Earth Station: Amazonas 2 at 61.0° W.
- Frequency Band: 13750.0 – 14000.0 GHz
- Polarizations: Linear and Circular
- Emissions: 128KG7D and 36M0G7W
- Modulation: Digital
- Maximum Aggregate Uplink EIRP: 128 KHz and 36 MHz
  55.0 dBW 74.9 dBW
- Transmit Antenna Characteristics
  Antenna Size: 4.5 meters in Diameter
  Antenna Type/Model: Andrew Corporation ES45MP-1
  Gain: 53.9 dBi

- RF power into Antenna Flange: 128 KHz Emission:
  1.1 dBW or 10.0 dBW/ MHz
  or -14.0 dBW/4 kHz (Maximum)

  36 MHz Emission:
  21.0 dBW or 5.5 dBW/ MHz
  or -18.5 dBW/4 kHz (Maximum)

- Minimum Elevation Angle:
  Miami, Florida 52.9° @ 141.4° Az. (Amazonas-2)

- Side Lobe Antenna Gain: 32 - 25*log(θ)

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 and (2) Data Relay Satellites.

Summary of Coordination Issues:

2) Potential Impact to Government Radiolocation (Shipboard Radar)
3) 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 Communications 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 $dBW/m^2/4$ kHz.

The closest distance to the shoreline from the Miami, Florida earth station is approximately 10.34 km east toward the Atlantic Ocean. The calculation of the power spectral density at this distance is given by

	128 kHz Emissions	36 MHz Emissions
1. Clear Sky EIRP:	55.0 dBW	74.9 dBW
2. Carrier Bandwidth:	128 kHz	36.0 MHz
3. PD at antenna input:	-14.0 dBW/4 kHz	-18.5 dBW/4 kHz
4. Transmit Antenna Gain:	53.9 dBi	
5. Antenna Gain Horizon:	FCC Reference Pattern	
6. Antenna Elevation Angle:	52.9°	

The proposed earth station will radiate interference toward the ocean according to its off-axis side-lobe performance. A conservative analysis, using FCC standard reference pattern, results in off-axis antenna gains of –10.0 dBi towards the Atlantic Ocean.

The calculated signal density at the shoreline (for a 128 kHz emission), through free space is:

PFD = Antenna Feed Power density (dBW/4 kHz) + Antenna Off-Axis Gain (dBi) – Spread Loss (dBw-m^2).

= -14.0 dBw/4 kHz + (-10.0) dBi – 10*log[4Π(10340m)^2]
= -115.3 dBW/m^2/4 kHz + Additional Path Losses (~ 4.4 dB)
= -119.7 dBW/ m^2/4 kHz

The calculated signal density at the shoreline (for a 36 MHz emission), through free space is:

PFD = Antenna Feed Power density (dBW/4 kHz) + Antenna Off-Axis Gain (dBi) – Spread Loss (dBw-m^2).

= -18.5 dBw/4 kHz + (-10.0) dBi – 10*log[4Π(10340m)^2]
= -119.8 dBW/m^2/4 kHz + Additional Path Losses (~ 4.4 dB)
= -124.2 dBW/ m^2/4 kHz

Our calculations show additional path losses of approximately 4.4 dB including absorption loss and earth diffraction loss for the actual path profiles from the proposed earth station to the nearest shoreline.

In an effort to analyze the effects of 128 kHz and 36 MHz earth station transmissions on naval radar systems, power flux densities were calculated from the earth station to the shipboard radars in increments from 6.4 miles to 60 miles (See Tables 2 and 3). The calculation of interference level to the RADAR sidelobes was made at the initial distance of 6.4 miles. A distance of 6.4 miles was used as the initial increment because it is the distance from the earth station site to the shoreline. This is the worst case condition. If the interference level is below the criteria at this range, it will be below the criteria at all of the greater ranges. A power flux density was also calculated from the shipboard radars to the shoreline and the reflection of the radar transmissions back to the radar. Since this flux density concerns the transmission from the ship to shore and back to the ship the mileage number is doubled. The power flux densities are based on the following formulas:

Earth Station to Naval Radars

$$P_{FD} = P_{ES}G_{ES} / 4\pi r^2$$

Where: P_{FD} = Power Flux Density
P_{ES} = Power of Earth Station (-14.0 dbW/4 kHz)
G_{ES} = Worst Case Earth Station Gain Toward the Shipboard Radars (-10.0 dB)
$4\pi = 10Log(4\pi) = -11.0$
r = Distance from ES to radars in Meters [Used 20Log(r)]

Naval Radars to Shore and Reflection back to the Radar Source

$$P_{FD} = P_T G_T / 4\pi (2r)^2 * (0.01 \text{ m}^2)$$

Where: P_{FD} = Power Flux Density
P_T = Power of Radar (Used 56.0 dBW for 1 MHz or 32 dBW for 4 kHz)
G_T = Gain of Radar (Used 44 dB)
$4\pi = 10Log(4\pi) = -11.0$
2r = Distance to Shoreline and Reflection back to Radar Source
$0.01m^2$ = Size of the Radar Sectional Area of Target

Based upon calculations from the above formulas, it was determined that reflections of the radar transmissions from the shoreline and back to the radar were 58.4 dB higher than the earth station transmissions (128 kHz), and 62.9 dB higher than the earth station transmissions (36 MHz) into the radar. These calculations are presented in the tables below. This being the case, it can be concluded that in the main beam, earth station operations should not be a problem for naval radar operations.

Table 2 (128 kHz Emissions)

Distance from ES to Radar (Miles)	Flux Density Interference From ES ($dBW/4\ kHz/m^2$)	Desired Radar Return from $(0.01m)^2$ Target ($dBW/4\ kHz/m^2$)	Radar Signal / ES Interference (dB)
6.4	-119.7	-61.3	58.4
8.0	-121.6	-63.2	58.4
10.0	-123.5	-65.2	58.4
15.0	-127.1	-68.7	58.4
20.0	-129.6	-71.2	58.4
30.0	-133.1	-74.7	58.4
40.0	-135.6	-77.2	58.4
50.0	-137.5	-79.1	58.4
60.0	-139.1	-80.7	58.4

The calculated PFD for the 128 kHz emissions, which include 4.4 dB of additional path losses to the shoreline location is –119.7 $dBW/m^2/4$ kHz. If off axis, side lobe considerations are made, 44 dB was used as the gain of the radar and -10.0 dBi was the radar antenna side lobe gain toward the direction of the earth station. This additional -54.0 dB will create an equivalent PFD of -173.7 $dBW/m^2/4$ kHz, which is 6.7 dB lower than the –167 $dBW/m^2/4$ kHz interference criteria of R&O 96-377.

Therefore, there should be no interference to the US Navy RADAR from the Miami earth station in both the main beam and side lobe of the radar.

Table 3 (36 MHz Emissions)

Distance from ES to Radar (Miles)	Flux Density Interference From ES ($dBW/4\ kHz/m^2$)	Desired Radar Return from $(0.01m)^2$ Target ($dBW/4\ kHz/m^2$)	Radar Signal / ES Interference (dB)
6.4	-124.2	-61.3	62.9
8.0	-126.1	-63.2	62.9
10.0	-128.0	-65.2	62.9
15.0	-131.6	-68.7	62.9
20.0	-134.1	-71.2	62.9
30.0	-137.6	-74.7	62.9
40.0	-140.1	-77.2	62.9
50.0	-142.0	-79.1	62.9
60.0	-143.6	-80.7	62.9

The calculated PFD for the 36 MHz emissions, which include 4.4 dB of additional path losses to the shoreline location is –124.2 $dBW/m^2/4$ kHz. If off axis, side lobe considerations are made, 44 dB was used as the gain of the radar and -10.0 dBi was the radar antenna side lobe gain toward the direction of the earth station. This additional -54.0 dB will create an equivalent PFD of -178.2 $dBW/m^2/4$ kHz, which is 11.2 dB lower than the –167 $dBW/m^2/4$ kHz interference criteria of R&O 96-377.

Therefore, there should be no interference to the US Navy RADAR from the Miami earth station in both the main beam and side lobe of the radar.

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

The geographic location of the Newcom International, Inc. Miami, Florida earth station 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 Newcom International earth station in Miami, Florida.

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 maximum EIRP for the 36 MHz carriers is 74.9 dBW, and the equivalent EIRP per 6 MHz segment for a 36 MHz carrier is 67.1 dBW/6 MHz. The maximum EIRP for the 128 kHz carriers will be 55.0 dBW. Therefore, those 128 kHz carriers will also meet the 71 dBW/6 MHz criteria.

4. Coordination Issue Result Summary and Conclusions

The results of the analysis and calculations performed in this exhibit indicate that operations between the Miami earth station, US Navy systems and NASA earth-to-space and space-to-space segments are compatible.

Interference into US Navy RADAR operations from the Miami, Florida earth station will not occur, and interference with NASA's TDRSS satellite will also not occur.