FAAST FCC Special Temporary Authorization (STA) Request

1 Purpose of Operation

Raytheon Network Centric Systems (NCS) has been developing a compact high gain active phase array antenna designed for operation with the Inmarsat Broadband Global Area Network (BGAN) system. The Raytheon antenna has been named the Flexible Array Antenna SATCOM Technology (FAAST) antenna. This FAAST antenna is designed to interface with an Inmarsat SATCOM modem manufactured by Hughes Network Systems that has also been approved by the FCC as detailed below. We are planning to conduct testing with the Inmarsat-4F2 BGAN Satellite from both fixed ground and mobile ground platforms from various locations within the United States.

- Inmarsat, Inc. has received a Nationwide Mobile FCC Experimental Radio Station Construction Permit and License:
  - File Number: 0059-EX-PL-2006
  - Class of Station: XD MO
  - Station Locations: MOBILE: NATIONWIDE
  - Effective: 2/23/06
  - Expiration: 9/1/06

  By its application, Inmarsat sought authority to operate four different types of mobile earth terminals in conjunction with the Inmarsat-4F2 satellite in order to allow Inmarsat, its manufacturers, distributors, and resellers to: (i) conduct technical demonstrations and testing of BGAN service and these terminals to ensure that performance is in accordance with design specifications; (ii) demonstrate performance of the terminals to prospective purchasers; and (iii) perform limited market studies.
- Hughes Network Systems of Germantown, MD has received an Equipment Authorization for a Licensed Non-Broadcast Station Transmitter under FCC Part 25 as a Broadband Satellite IP Modem with Emission Designator D1W and FCC Identifier K3YHNS9201.

The Raytheon FAAST active phase array antenna will be connected to the HNS 9201 Broadband Satellite IP Modem, replacing the fixed beam antenna that is integral to the HNS 9201 modem. The FAAST Phase Array antenna will be the transmit/receive antenna for the HNS modem as it communicates with the Inmarsat-4F2 satellite during our desired demonstrations and tests.

2 STA Explanation

As detailed in paragraph 1 above, Raytheon seeks this STA in order to allow testing and technical demonstrations of the mobile FAAST Phase Array antenna with the Inmarsat-4F2 satellite, as well as demonstrating performance of the FAAST Phase Array Antenna/HNS Broadband modem system to prospective buyers, predominantly DOD. These Raytheon objectives are in line with the Inmarsat, Inc. objectives in seeking and acquiring the above mentioned FCC Experimental License for Nationwide Mobile locations.

3 Equipment Information

As indicated in Paragraph 1, Raytheon will be integrating the FAAST Phase Array antenna with the FCC Approved Hughes Network Systems Broadband Satellite Modem.

3.1 Transmitter information

Manufacturer:

Hughes Network Systems

Germantown, MD

Model: HNS 9201

Number of units 1

Experimental (Y/N) N

The HNS transmitter operates within the tunable frequencies shown in Table 1, with a frequency tolerance of 5.0 PPM.

3.2 FAAST System Transmitter Emission Designator

The FAAST system, consisting of the FAAST Active Phase Array antenna, coupled to the HNS 9201 modem will transmit in the frequency range indicated in Table 1. The system transmitted EIRP varies with scan angle of the phase array antenna, as indicated in Table 1.

Finally, the Emission Designator is 33M9D1W.

3.3 Antenna Information

The FAAST antenna is an Active Phase Array antenna, operating with the characteristics shown in Table 1. We plan to radiate at EIRP levels shown in Table 1 with a beam that is approximately 30º beamwidth at the half-power points.

Antenna Parameter	Projected Performance
Tunable frequency range	Transmit: 1.6266 to 1.6605 GHz Receive: 1.525 to 1.559 GHz
Frequency Tolerance	5.0 PPM
Instantaneous Channel Bandwidth	200 KHz Min
Scan Range (System)	360° in Az -10º to + 90º El
EIRP (for 16-QAM modulation)	0º scan angle : 23.2 dBW 65º scan angle: 19.5 dBW 80º scan angle: 15.6 dBW
Polarization	RH Circular
Polarization Axial Ratio	≤ 3 dB
Side Lobe Peak	< –12dB
Power out at 1 dB compression, per element	0.5 W (max)
Half-power beamwidth	Approx. 30º
Third order intermod distortion (Adj. channel interference)	-30 dB Max
Effective Aperture Size	Variable
G/T (over scan range)	-15 dB (min) to -10 dB (objective)
Radome	Standard approaches

Table 1: Performance Characteristics for the Raytheon FAAST antenna

FAAST is a tracking antenna that uses a GPS and orientation sensor subsystem to determine the antenna orientation and position. From this information, the scanning angle to the geostationary Inmarsat-4F2 is determined. Our estimated pointing error is less than 2º. Given the 30º beamwidth, this pointing accuracy is more than sufficient.

The antenna has a foot print of approximately 24 in. x 24 in., shaped like a hollow carapace with a central height of approximately 5 inches. Anticipated installation on top of a HMWWV is shown in Figure 1 by way of example.

By way of description, the antenna is assembled from a basic subarray consisting of 4 radiator elements in a 2 x 2 subarray tile. The top surface consists of 4 each of the subarray, providing a total of 16 radiators on the top. This top element is shown in the photo of Figure 1. To enable the required scan angle performance when mounted to the top surface of a vehicle, the four sides are tilted up at 45º creating a truncated pyramid. The

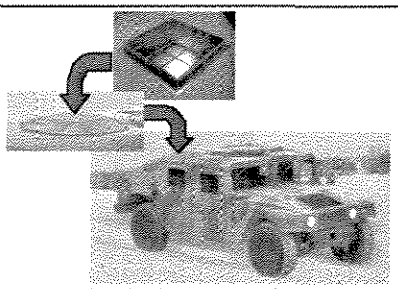

Figure 1: A 16 element subarray (photo) forms the top section of the FAAST carapace. The full antenna is depicted attached to the top of a HMWWV only as an example.

sides are composed of 2 each of the basic subarray, providing 8 radiating elements on each side. This results in a total number of available radiators at 48. Given the geometry of the antenna and its location on vehicles, the number of elements that are radiating at any one time is limited to 32 elements: the top plus 2 sides. This geometry provides the projected EIRP levels of Table 1.

3.4 System Characteristics

3.4.1 RF output at the transmitter terminals.

The peak power of the HNS modem is 40.6 Watts. This power output is attenuated to 25.4 dBm at the input of each 4 element subarray.

3.4.2 Effective radiated power from the antenna

As described above, a total of 32 individual radiating elements are active at any one time, resulting in the projected EIRP versus scan angle of Table 1. The prototype design is currently being tested, and final data will be provided when available.

This power is radiated at the Inmarsat-4F2 satellite with an estimated half-power beam width of 30º as indicated in Table 1. Again, prototype data will be provided when available.

3.4.3 Modulation Types

The modulation type will be automatically and dynamically determined based on measured antenna performance. As a high gain antenna coupled with a high performance and high bandwidth modem, it is anticipated that the modulation scheme will be at least QPSK for 256 kbps, with the highest data transfer at 16-QAM (492 kbps) in accordance with Inmarsat BGAN service.

3.4.4 Testing and Demonstration Locations

We are requesting general approval for testing and demonstrations with our FAAST experimental system nationwide, similar to Inmarsat's Nationwide Mobile Experimental License.

While yet to be finalized, demonstration venues are anticipated as being mobile vehicular platform(s) at the following minimum locations:

- Raytheon NCS headquarters, McKinney, TX
  Coordinates: 33º 12' 52.06" N
  96º 39' 23.71" W
- Fort Benning, GA
  Coordinates: 32º 22' 20.04" N
  84º 56' 46.15" W
- Fort Gordon, GA
  Coordinates: 33º 25' 14.13" N
  82º 08' 22.60" W
- US Army TRADOC headquarters, Fort Monroe, VA
  Coordinates: 37º 01' 01.24" N
  76º 18' 01.56" W

3.4.5 FAAST Directional Antenna Characteristics

As stated above, FAAST is an Active Phase Array antenna. It is capable of steering a full 360º in azimuth, and scan angles to > 85º from vertical. As such, it is capable of covering almost the full hemisphere above the vehicle. This feature enables high bandwidth communications on the move

as the vehicle maneuvers in a tactical environment. As indicated in Table 1, the beam width at the half power point is approximately 30º with right hand circular polarization.

As shown in Figure 1, the FAAST antenna Concept of Operations (CONOPS) is to mount the antenna near the top surface of a vehicle to enable unobstructed line of sight (LOS) to the GEO Inmarsat-4F2.

3.5 Confidentiality

No confidentiality is requested for this application.