Extremely Wideband Antenna for Airborne and Land Mobile Communications Systems

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PROBLEM STATEMENT

Joint Forces interoperability systems such as the Joint Tactical Radio System (JTRS) require antennas that are extremely broadband. Some of the joint systems operate in High Frequency/Very High Frequency/Ultra High Frequency (HF/VHF/UHF) and L-Bands and require antennas that can operate from 2-2000 MHz. Currently available antennas are not capable of providing continuous operation over the JTRS AMF band while maintaining compatibility with legacy radios from a form factor that is conducive to high speed flight.

WHO CAN BENEFIT?

The JTRS Airborne and Maritime /Fixed Station (AMF) program is the targeted platform for this technology. The Joint Program Executive Office for the Joint Tactical Radio System (JPEO JTRS) manages, the JTRS AMF program. Lockheed-Martin primes the JTRS-AMF program.

This antenna can be utilized on all air vehicles that require bandwidth from 225-2000 Megahertz (MHz) bandwidth. It is anticipated that the antenna will be qualified on high-speed jet aircraft which will enable it be used on nearly all-military air vehicles. However, the design specifically incorporates features that allow functional expansion down to VHF (30 MHz) in order to provide compatibility with VHF push-to-talk radios (i.e., Single Channel Ground and Airborne Radio System - SINCGARS). This eliminates the requirements for separate apertures to cover the VHF band as well as the JTRS bands. Though a 225 – 2000 MHz is the threshold goal of the program, the objective is 30 – 2000 MHz.

The antenna will benefit prime contractors for air vehicle platforms as well as commercial organizations that integrate avionic systems for air vehicles.

BASELINE TECHNOLOGY

Outside of First RF, there are two companies that market airborne antenna that could cover the bandwidth requirements of the JTRS-AMF program. However, the First RF antenna offers three benefits over the existing airborne blade antenna solutions available:

1. RF performance: The First RF antenna is designed to operate continuously from 225 – 2000 MHz. Antennas currently being marketed have a band break at 450 MHz, or have a band break (with reduced performance) from 450 – 1200 MHz.
2. Mechanical design: First RF's design incorporates environmental and mechanical considerations taken directly from Navy's specification document for airborne blade antennas, MIL-A-5815 and MIL-A-5815/1. It is not clear that competitive solutions will hold up to high-speed flight.
3. Aperture consolidation: First RF's design allows function expansion to include the SINCGARS band with a package that can survive high-speed flight.

TECHNOLOGY DESCRIPTION

The design incorporates First RF's ultra-broadband planar antenna technology. Bandwidths of over 300:1 have been achieved for high-power EW applications. The challenge here is to shrink the size/footprint for use aboard a high speed aircraft. This involves a combination of proprietary RF/antenna designs, as well as mechanical/environmental/structural design of a radome to facilitate the harsh high speed and high altitude maneuvers.

The antenna footprint is identical to that of the AS-3191/A, AS-3792/A, and AS-3793/A antenna (Navy's airborne VHF/UHF antenna), but with a smaller vertical profile of only 8" (versus 14.4" for the legacy design), conducive to installation aboard high speed aircraft. A single port connector drives the antenna from 225 – 2000 MHz, with gains ranging from -2 dB at 225 MHz to 2 dB at the high end of the band. The antenna pattern is that of a monopole, linear-vertical. Expansion capability exists for operation down to 30 MHz in order to maintain compatibility with existing airborne SINCGARS radios. Because of the frequency bands covered by this antenna, and because the antenna maintains the same physical footprint as existing airborne VHF/UHF antennas, this approach eliminates the need to 'cut' an additional hole in the aircraft to accommodate JTRS.

Features	Advantages	Benefits
Wideband continuous coverage from 225 – 2000 MHz	No band breaks	Provides access to the full COMMs spectrum; no antenna exists which fills this need
Expansion down to 30 MHz	Provides coverage over the VHF SINCGARS band	Combines multiple antennas into a common package, reducing the antenna count aboard the aircraft.
Form factor: low profile aerodynamic blade	Minimizes drag and wind-loading	Antenna will be environmentally and physically qualified for a high speed jet
Supports 200W operation	Compatible with existing high power SATCOM radios	Combines LOS and JTRS into one package

CURRENT STATE OF DEVELOPMENT

As of October, 2010 the technology is TRL-6. The baseline RF radiator design has been proven. The remaining activities will be focused on specific integration issues such as the radome and construction/manufacturability considerations.

REFERENCES

TPOC – 619-553-2584

WHEN THE TECHNOLOGY WILL BE READY FOR USE

By April 2011, First RF will have a flight-qualified design with compatibility to existing Navy VHF/UHF environmental requirements.

ABOUT THE COMPANY

First RF headquarters are located in Boulder, Colorado. Our 30,000 square foot facility co-locates office, laboratory, machine shop, and test facilities. An additional 25,000 square foot facility houses production, assembly and warehousing. With 45 Phase I and 27 Phase II awards, we devote significant resources to marketing, transitioning and commercializing the government's SBIR investment. For example, the largest antenna production program in DoD history began as a Phase I program in 2004 with First RF, and since then, over 140,000 antennas have been produced. This antenna supports ultra-wideband Electronic Warfare against radio-IED threats in the Middle East.