2017-11

Critical Vulnerabilities in the Space Domain

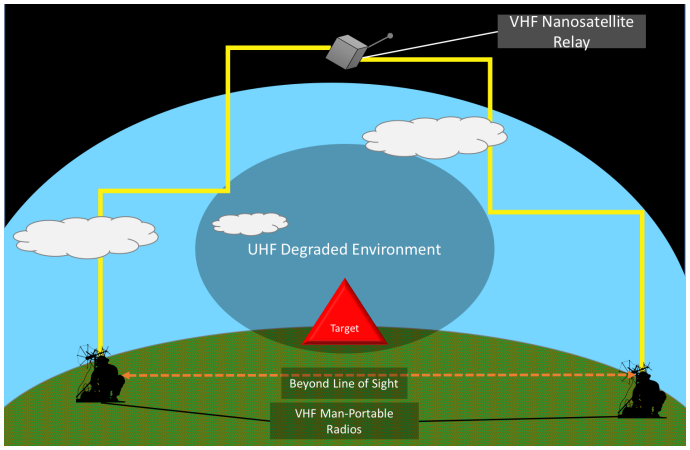
Swintek, Philip

Critical Vulnerabilities in the Space Domain

Naval Postgraduate School

Using Nanosatellites as an Alternative to Traditional Satellite Communications

The U.S. military relies on space-based technology for a myriad of functions from precision navigation and timing to Satellite Communications (SATCOM). As a safeguard against the U.S. military's dependence on space-based technology, nanosatellites are a low cost and expedient near-term solution to support the U.S. military and in particular U.S. Special Operations Forces (SOF) across the globe. Furthermore, nanosatellites offer unique solutions in a degraded or resource-limited space environment as an alternative to traditional SATCOM architectures. Specifically, a constellation of nanosatellites in low earth orbit with a payload consisting of a simple Software Defined Radio (SDR) operating as a Very High Frequency (VHF) relay would provide an alternative method for satellite voice communications. Building a low-cost payload utilizing emerging SDR technology and testing the payload in both the laboratory environment and on a high-altitude balloon will demonstrate the feasibility and utility of such a payload for protecting against current U.S. military vulnerabilities.



Concept of Operations

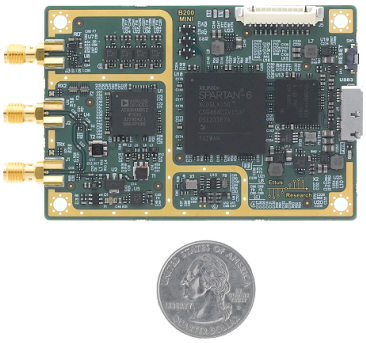
Method and Approach

In-depth research, coupled with scientific testing and modeling, will illuminate the depth of the problem, while providing a potential solution.

- Illuminate the depth of the U.S. military's reliance on space-based technology.
- Research nanosatellite applications.
- Build a model nanosatellite constellation.
- Develop a prototype payload to act as relay for VHF radios using a software defined radio.
- Iteratively test the payload in the laboratory to ensure the communications link will close.
- Test the payload using a high altitude balloon to simulate in-flight operations.

Research Question: Given that the American way of war is now inexorably linked to space-based technology and thus increasingly vulnerable, how can nanosatellites be utilized as an alternative to traditional satellite communications architectures to protect against adversaries capable of exploiting such vulnerabilities?

Hypothesis: Nanosatellites are a low cost and expedient near-term solution for this vulnerability. A constellation of nanosatellites in low earth orbit with a payload consisting of a software defined radio programmed as a VHF relay will provide an alternative method for satellite communications.



Ettus Corporation's B205-mini Software Defined Radio

The payload will enable non-SATCOM capable VHF radios in a degraded space environment—a solution to a critical vulnerability.

Thesis Author: Major Philip Swintek, Student, Department of Defense Analysis
Thesis Advisors: Dr. Leo Blanken, Associate Professor, Department of Defense Analysis; Dr. Wenschel Lan, Research Associate, Space Systems Academic Group; Lieutenant Colonel Scott Moore, Military Assistant Professor, Space Systems Academic Group
Thesis Sponsor: Space and Naval Warfare Systems Center-Pacific (SSC-PAC)