

# **MASTER OF SCIENCE IN ASTRONAUTICAL ENGINEERING**

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## **DEVELOPMENT OF A TACTICAL EHF MICROSATELLITE COMMUNICATION SYSTEM**

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**Master of Science in Astronautical Engineering-June 1999**

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Recent developments in microsatellite technology has enabled a more energetic examination of small, space-based communication and other intelligence-gathering systems and the exploitation of the millimeter wave segment of the electromagnetic spectrum. This thesis develops these emerging technologies and incorporates them into an affordable and compatible communication system for use by the theater commander using already fielded hardware. The extremely high frequency spectrum promotes a low probability of intercept/detect and permits the use of lightweight, mobile ground terminals facilitating use in a tactical environment. Completing the link between the theater commander and his assets in the battle field is a constellation of low earth orbiting microsatellites providing 24 hour bentpipe communication connectivity for a duration of approximately two years. These microsatellites can be launched aboard the Trident missile, with at least three microsatellites packed into each missile fairing. Other packing options are discussed increasing missile complements to eight microsatellites per missile. Further discussion expounds the virtues of EHF communications and introduces concepts to increase data rates.

**DoD KEY TECHNOLOGY AREAS:** Command, Control, and Communications, Space Vehicles, Aerospace Propulsion and Power

**KEYWORDS:** EHF Spectrum, EHF Microsatellite, SCAMP, SMAD Software

## **ANALYSIS OF THE FEASIBILITY OF SUBMARINE LAUNCHED SATELLITE CONSTELLATIONS**

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The pace and complexity of military operations increasingly places a greater demand on satellite-provided services ranging from communications to intelligence gathering. Development of microsatellite technology has made it possible to launch satellites from organic sea assets. This thesis has developed feasible constellations that can be populated using the Trident II as a launch vehicle. Various constellation designs are analyzed and compared. Design emphasis concentrated on a Walker constellation and a custom satellite constellation derived from the Walker constellation. Coverage goals were repetitive access windows to specific target areas. For the development of this thesis, Iraq and the Persian Gulf were the targets of interest and the design focused on optimizing orbital parameters to achieve useful coverage over this region. Total coverage is provided with 24 satellites. The benefits of sea-based launches are discussed. Options for incorporating satellite launch capability into the United States Navy's arsenal are also discussed.

## ASTRONAUTICAL ENGINEERING

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**DoD KEY TECHNOLOGY AREAS:** Space Vehicles, Command, Control, and Communications, Modeling and Simulation

**KEYWORDS:** Constellation Design, Submarine Launched Satellites, Trident II, Trident D5, Satellite Coverage