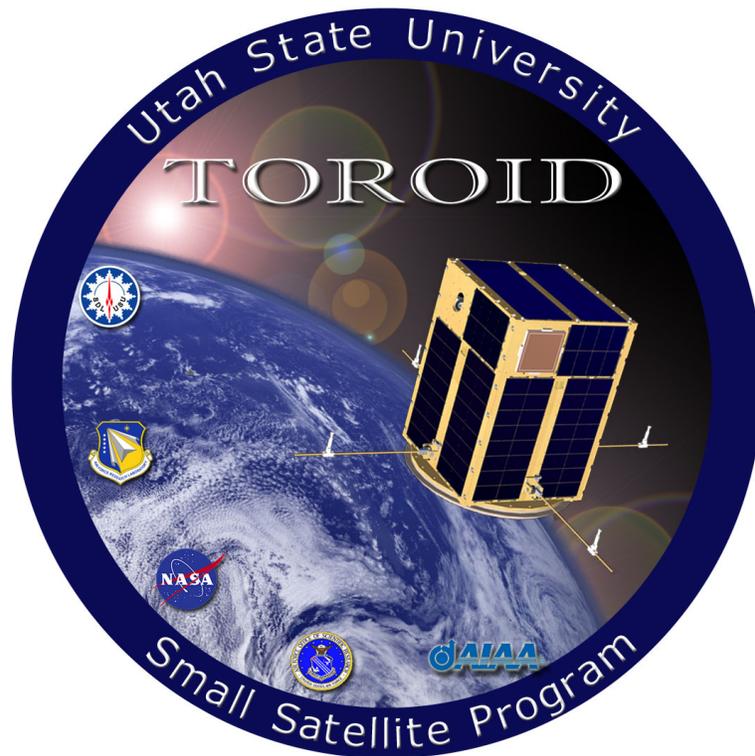


# USU<sub>sat</sub> III TOROID

## Request for Proposals

### Ground Station Controller



## University Nanosat IV Program

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## **1.0 Introduction**

Utah State University, in conjunction with the University Nanosat 4 Program, is currently designing, testing, and fabricating a small satellite named TOROID. This spacecraft will be designed, assembled and readied for launch within a two-year period. The proposed science mission is one of interest to both NASA and the Air Force and involves a study of disturbances in the Earth's ionosphere. The proposed spacecraft, TOROID, is an evolutionary design from the USUSat, Combat Sentinel, and USUSat II programs. The primary science instrument, TOROID - TOMographic Remote Observer of Ionospheric Disturbances, is a photometer to measure the airglow due to electron and oxygen ion recombination. The data will be gathered in such a way that tomographic techniques can be used to construct an altitude profile of ionospheric density along the spacecraft trajectory. This project will not only be used to develop, explore and demonstrate new small satellite technologies, but it will also be able to gather meaningful scientific data on the fundamental parameters of ionospheric density irregularities that effect radio wave propagation for communications, navigation, and the Global Positioning System.

The University Nanosat 4 Program is a national competition sponsored by the AFRL Space Vehicles Directorate (AFRL/VS), NASA Goddard Space Flight Center (GSFC), and the American Institute of Aeronautics and Astronautics (AIAA). This program is intended to promote the education of future spacecraft systems engineers, at the university level, motivate and sustain related research on targeted technologies by focusing on the development of small satellites (nanosats) or flight experiments, and inspire the interest of students, below the university level, for careers in space. The primary outcome of individual projects funded under this program is the design, fabrication and functional testing of a Nanosat. Secondary objectives are to foster research in enabling technologies for nanosats and the design of experiments that can be performed by nanosats in orbit

## **2.0 Eligibility**

This request for proposals is limited to students currently enrolled in the Mechanical and Aerospace Engineering and Electrical and Computer Engineering departments at Utah State University. Collaborations among the different disciplines are encouraged.

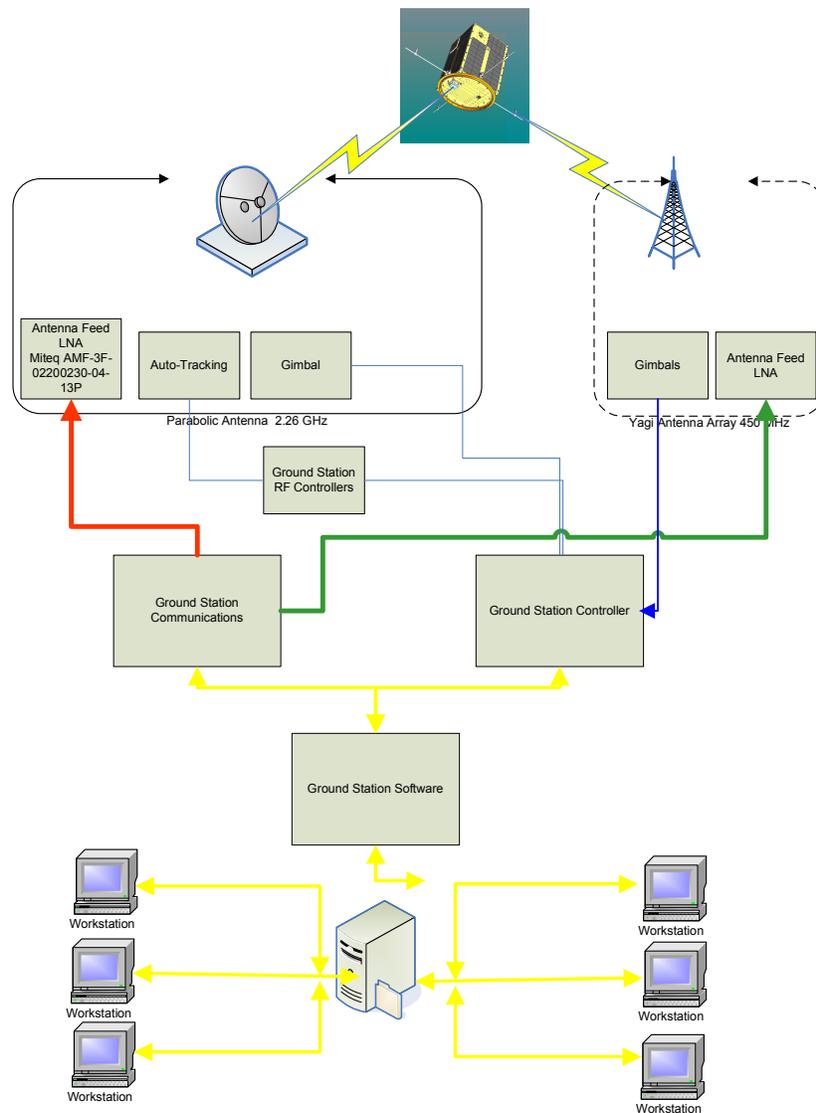
## **3.0 Objectives**

### **3.1 Requirements**

An operating ground station is key to the success of Utah State University's submission to the University Nanosat 4 Program. This ground station consists of three

major sections, the ground station communications design, ground station controller design and ground station software design. This solicitation encompasses the design of the ground station controller.

The USU Ground Station consists of one 4.5 meter parabolic antenna, and two cross yagi antennas. These antennas must track the satellite during all access periods. This is to be accomplished through two methods. The antennas must track using information provided daily from NORAD in the form of two line element sets. Additionally the antennas will be able to track the satellite through auto-tracking. The system architecture has already been designed, and can be seen in the block diagram found below. Your team shall develop a controller that will fit into the architecture as shown. This proposal is intended for a team of one to two engineers.



**Figure 1: Ground Station Block Diagram**

**Table 1: Ground Station System Requirements**

S2-35.1	Ground station antenna shall be able to rotate a minimum 1.15 degrees per second
S2-35.2	Ground station shall be able to track the satellite with both auto-tracking and software tracking
S2-35.3	Ground station shall be able view the satellite unobstructed across entire pass.

Above is a list of system level requirements for the ground station. Any proposal will include a list of sub-system requirements related to these requirements. Additionally, a final report shall be submitted, showing sub-system requirements and the design used to meet those requirements. This report shall also include all models, code, analysis and testing done as part of the design.

### **3.2 Cost**

There is no defined cost cap for this project, but all expenses shall be approved by the USUSat Program Manager. However, costs must be kept to a minimum.

### **3.3 Educational Objectives**

This RFP is intended to solicit proposals from students in the MAE and ECE departments at Utah State University, in order to meet requirements for a senior design project. As such, all proposals, reports and presentations shall adhere to MAE and ECE department policies regarding senior design projects.

### **4.0 Program Overview**

All senior project associated with the Small Satellite Program are divided into four stages. First is the proposal stage, where interested parties submit proposals for each potential project. This stage is followed by the Preliminary design stage. This stage reviews the projects concept and feasibility, as well as adherence to requirements established in this document. The Critical Design Review follows next. This stage reviews the design, checks adherence to this document and to TOROID design guidelines. The final stage is the Final Design Review, where all deliverable requirements must be met. Should hardware be part of an accepted proposal, it must be delivered at this time. Below is chart showing this schedule

<b>Design Review</b>	<b>Data/Hardware Item</b>	<b>Delivery Requirement</b>
Proposal	<ul style="list-style-type: none"> <li>▪ Preliminary schedule</li> <li>▪ Resource and personnel budget</li> <li>▪ Overall Concept of design</li> </ul>	September 28, 2005
PDR	<ul style="list-style-type: none"> <li>▪ Presentation Slides</li> <li>▪ Preliminary Drawings and Schematics</li> <li>▪ Preliminary budgets and analyses</li> </ul>	7 Days Prior to review
CDR	<ul style="list-style-type: none"> <li>▪ Presentation Slides</li> <li>▪ Budgets and analyses</li> <li>▪ Detailed Drawings and Schematics</li> <li>▪ Preliminary Test Plans and preliminary test results</li> <li>▪ Assembly Plans</li> </ul>	Drawings: 14 days prior to review All Else: 7 days prior to review
FDR	<ul style="list-style-type: none"> <li>▪ Presentation Slides</li> <li>▪ Complete Drawings and Schematics</li> <li>▪ Budgets and Schematics</li> <li>▪ Test Plans and Results</li> <li>▪ Assembly Plans</li> <li>▪ Protoflight Hardware/Simulation Results</li> </ul>	Drawings: 14 days prior to review All Else: 7 days prior to review

## 5.0 Submission Requirements

Two copies of the proposal should be emailed or submitted to:

Matthew D. Carney  
[mdcarney@cc.usu.edu](mailto:mdcarney@cc.usu.edu)

USUSat Program  
Office: Engineering Laboratory 206B  
4170 Old Main Hill  
Logan, UT 84322-4170

Additional copies may need to be submitted to supervising professor as well. Proposals should be submitted no later than September 28, 2005 at 7:00 am.

Address questions to: Matthew Carney, [mdcarney@cc.usu.edu](mailto:mdcarney@cc.usu.edu)