

**ANTS 2:**

Shane Almeida  
Ethan Croteau  
Jonathan Freyberger

**Mentors**

Mike Rilee  
Email: Michael.L.Rilee.1@gsfc.nasa.gov  
Phone: 301 – 286 – 4743

Walter Truskowski  
Email: Walt.Truskowski@gsfc.nasa.gov  
Phone: 301 – 286 – 8821

**Work location**

Building #23, Room E 409  
Phone: 301 – 286 – 7873

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## First Week Update

The purpose of our project is to design a layer of artificial intelligence that will allow the proposed mission to be completed. The proposed mission is to survey an asteroid in the asteroid belt. To do this, two satellites will be used. One satellite will be the ruler which is responsible for finding an asteroid worth surveying. The other satellite will be the worker which is responsible for actually surveying the asteroid. These two satellites must work together in order to complete the mission.

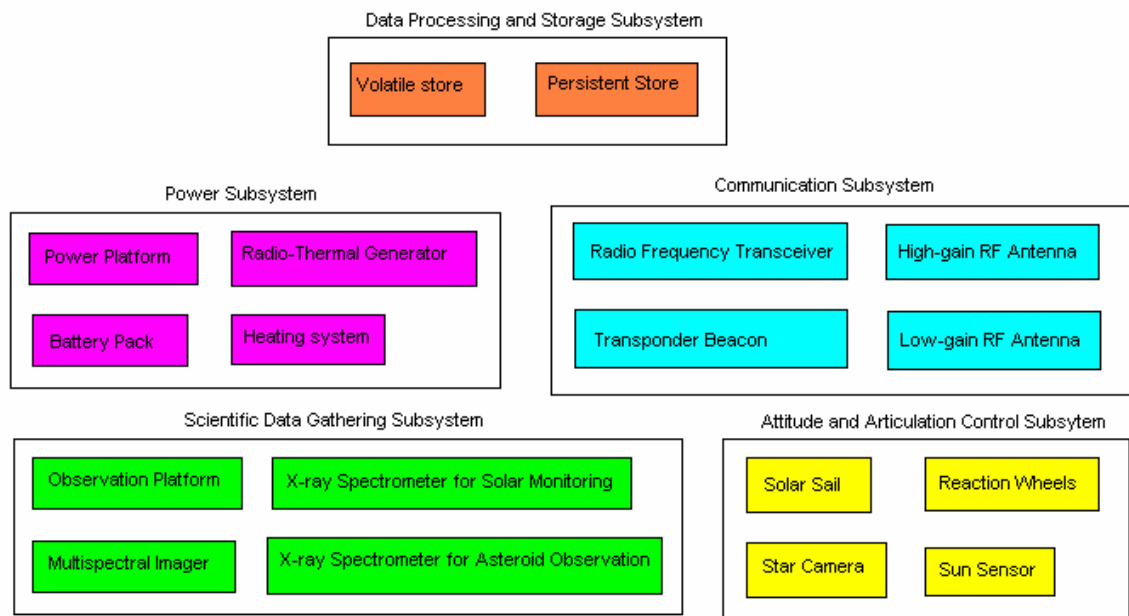
We will be provided with a simulated environment that the two satellites operate in. It is our job to read in information about the simulated environment and make actions based on that information. The satellites will interact with the environment through simulated satellite components. The basic components of a satellite that will be used are:

- Solar sail (sail, beam, actuators)
- Main bus (mechanical support & fixture, power, communications)
- Observations platform, truss, and actuators
- Battery pack
- Radio-Thermal Generator
- Heaters, heat conduits and radiators
- Star camera
- Sun sensor
- Multispectral imager
- Reaction wheels
- X-ray spectrometer for asteroid observation
- X-ray spectrometer for solar monitoring
- Radio frequency transceiver
- High-gain RF antenna
- Low-gain RF antenna
- Transponder beacon
- Persistent store
- Volatile store
- Computer

By reading the information obtained from these components the satellites will be able to determine their state within the environment. By sending information to these various components the satellites will be able to alter their state in the environment. One of our tasks is to define an agreed upon input and output for these components. For the

simulation there will be some abstraction with these components. This is because it is not the focus of project to see that every detail of how the satellite components function. Our goal is to explore how artificial intelligence can be used to complete the mission. Thus, at this point it is only necessary to have a general knowledge of how these spacecraft components function and how they will be used to complete the mission. Therefore, the input and output for each component needs to be such that it reflects how the actual component works, but at the same time is simplified so that it is easy to work with and will not deter us for our primary goal.

These basic satellite components have been incorporated into five general subsystems. The five general subsystems are communication, scientific data gathering, attitude and articulation control, power, and data processing and storage. The following Figure depicts these five general subsystems.

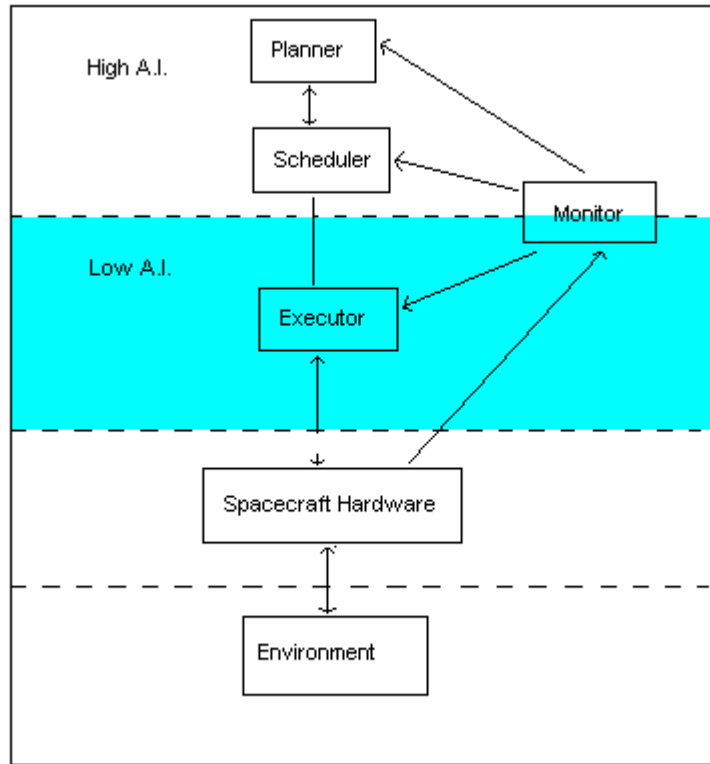


**Figure 1. Subsystem Breakdown: The five main subsystems on the satellite are data processing and storage, power, communication, scientific data gathering, and attitude and articulation control.**

The artificial intelligence software that we will be developing will sit on top of these five main subsystems and will be responsible for making sure each subsystem and

its components are functioning correctly. Our layer of software must also intelligently respond to encountered errors and malfunctions. The layer of A.I. that we are developing will sit under another layer of A.I. that is being developed by the ANTS 1 group. The ANTS 1 group will be responsible for high level mission planning and system scheduling. A general proposal for how the two layers of A.I will interact has been formed based on the remote agent experiment conducted by the Deep Space 1 project. The Deep Space 1 project implemented three separate technologies: an on board Planner/Scheduler, a Smart Executive, and a Mode Identification and Recovery (MIR) system. The job of the Scheduler is to generate plans or events that must take place in order to accomplish a goal. The Smart Executive executes the plans or events that the Scheduler has deemed necessary by sending commands to the satellite's underlying hardware. The MIR system is responsible for eavesdropping on the Smart Executive and making sure that the hardware the Smart Executive is communicating with is producing the desired results.

For our project it is proposed that a similar model be adopted. The ANTS 1 team will be responsible for the high level operations conducted by the Planner/Scheduler and our team (ANTS 2) will be in charge of the Smart Executer. Since both the low level and high level software needs to be aware of errors the functionality of the MIR would be divided between the two levels. The following figure displays this proposed division, our portion of the project being the colored section.



**Figure 2: Proposed division of Artificial intelligence**

Thus a potential scenario would be for the Planner to set the goal of locating potential asteroids and selecting one to survey. In order to satisfy this goal the scheduler would realize that it needs to scan nearby asteroids and then process the data received for unexamined asteroids. The Scheduler would then send these commands to the Executor. The Executor would be responsible for actually firing up the multi-spectral imager and data processor. While this is happening the MIR would be monitoring the hardware that the Executor is operating, making sure that it is operating smoothly. If a problem is encountered then the MIR and the Executor would attempt to rectify the situation. However, if the problem can not be fixed by these two components it is passed up to the Planner and Scheduler by the MIR.

### **List of Tasks**

Define Project

Revise previous writing

Begin writing new sections for final report

Define requirements for our project

Analyze the different components need to complete the project

Implement components

Document code

Finalize all writing

Final presentation

Present final report and working simulation