Team Bravo Request for Proposal

Saint Louis University



by

Jennifer Babb

Bryant Gaume

Tyler Olson

Tom Moline

Nate Richard

Copper Operational

Test Plan

Table of Contents

[1. Introduction 2](#_Toc370326609)

[2. Mission Overview 5](#_Toc370326610)

[2.1. Mission Objective 5](#_Toc370326611)

[2.2. Mission Success Criteria 5](#_Toc370326612)

# Introduction

Before describing the proposed mission in detail, it is important to establish the meanings of various terms that are associated with any given CubeSat mission. Firstly, 1U, or one standard unit, is defined as a cube of a uniform edge length of 10 cm. A CubeSat-Class satellite (aka a “nanosatellite”) is a satellite whose dimensions derive from 1 or more of these standard units. The reason for creating such satellites is twofold: it greatly reduces the time and monetary investment associated with developing custom satellite shapes and structures, while also allowing the development of standard satellite deployers (such as the P-POD or NLAS deployer) for integration into any rocket configuration, thus allowing greater access to launch opportunities for university missions. The largest-volume deployer currently being manufactured can accommodate a 6U spacecraft configuration.

Thus, the proposed mission shall have to fit within the 6U architecture dictated by these available deployers. Beyond this requirement, the requirements for the proposed mission consist of demonstrations of key proximity operations, such as stationkeeping, “escape” maneuvers, and rendezvous, the definitions of which are described in Table 1-1 below.

Table 1-1. Key Proximity Operations Definitions

|  |  |
| --- | --- |
| **Proximity Operation** | **Definition** |
| Stationkeeping | Maintaining a set relative displacement between two space objects for a period of several orbits |
| “Escape” Maneuver | Performing an orbital maneuver that increases the relative displacement between two space objects, as to avoid on-orbit collisions and potential orbital debris creation. |
| Rendezvous | Performing an orbital maneuver that decreases the relative displacement between two space objects within a set distance for a period of several orbits. |

Along with having to demonstrate these key proximity operations, the proposed mission also has several constraints on its successful execution. One such constraint is mission lifetime, and thus, the range of orbits over which the mission can take place and still allow for the completion of all mission requirements, as described in the next section. Assuming a mission lifetime of at least 6 months, the minimum orbit at which the mission can be placed and still be able to complete said mission objectives is 300 km, which is easily reachable with launch providers that have taken missions such as this to low earth orbit (LEO) in the past.

Along with this lower orbit bound, an upper orbit bound of 900 km can be set, since very few, if any, launch providers have transported past CubeSat mission beyond this point in recent memory.

Finally, a maximum mission mass of 8 kg can be set, as defined by the standard 6U CubeSat specification.

The mission constraints discussed in the previous paragraph are listed in Table 1-2 below:

Table 1-2. Proposed Mission Constraints

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Mass** | **Cube Size** | **Desired Orbit** | | **Acceptable Orbit Range** | **Desired Mission Life** |
| 8 kg | 6U | Altitude | 400 km | 300-900 km  40⁰-100⁰ | 6 Months |
| Inclination | 40⁰ |

# Mission Overview

## Mission Objective

The proposed mission shall demonstrate proximity operations and rendezvous within a 6U spacecraft architecture.

## Mission Success Criteria

The success of the proposed mission in meeting this mission objective will be determined by several mission objectives, three of which are listed below.

**The proposed mission shall demonstrate:**

1. Stationkeeping within a 10-100 m sphere of a resident space object.
2. An “Escape Maneuver” by performing an orbital maneuver that intentionally increases the final relative displacement between a spacecraft and a resident space object.
3. Rendezvous by performing an orbital maneuver that decreases the final relative displacement between a spacecraft and a resident space object.

.