



College of Engineering

# CS CAPSTONE REQUIREMENTS DOCUMENT

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## 100K SPACEPORT AMERICA DEMONSTRATION ROCKET PROJECT

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### Abstract

The Transmission protocol and Kalman filter we shall maximize data integrity. The Ground Station shall collect the data in near real time, and display this data to the screen at a constant refresh rate. The visualization will be human readable and display the best known approximation of the position of the rocket. The following details the features and expectations of the software we shall be developing.

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# 1 INTRODUCTION

## 1.1 Purpose

This document shall serve going forth as a description of the requirements and expectations of the software created by the computer science sub team for the 100k rocketry challenge.

## 1.2 Scope

The software created by this sub-team shall, in conjunction with electrical sub- team, create a transmission protocol and Kalman filter to transmit and receive the data as accurately as possible. The data shall be stored on the ground station. There shall also be a visualization that can present this data to the user. This implies:

- 1) The rocket can be tracked and recovers.
- 2) The highest altitude can be recorded.
- 3) The user will be able to view the data at a rate that is readable.

## 1.3 Definitions and Acronyms

Blackout: A long period where no data is recovered.

Corruption: When data in transmission changes value due to interference.

Data: Measurements of importance.

GS: Ground Station, a computer on the ground used during the flight.

GUI: Graphical User Interface. A visual interface with the software.

JSON: JavaScript Object Notation. A way of annotating data.

Kalman Filter: A system which uses both data and an ideal model to make a best estimate.

KATE: A software package for making announcements at certain altitudes.

Noise: Improper readings from sensors due to its constraints.

Packet: a complete set of data that is transmitted.

Packet Loss: When a packet does not reach the destination.

Protocol: The system for packaging and transmitting the telemetry data.

Serial: Data transferred sequentially over a single data line.

Telemetry: The data used for tracking the data.

## 1.4 Overview

The remainder of this document describes in more detail the aspects and requirements of the software. This shall involve the interaction between our software and the other aspects of the project. The following section, *Overall Description*, shall give a broad description of what our software shall do and the factors we must work with. The last section, *Specific Requirements*, shall put forth in detail the exact expectations of the software we shall deliver.

# 2 OVERALL DESCRIPTION

## 2.1 Product Perspective

The transmission protocol shall transmit the data from the rocket to the GS as accurately as possible. There shall also be a Kalman filter that will help to keep the data accurate beyond the capabilities of the protocol and the noise associated

with the sensors. The GS will receive data via a wireless interface with the rocket. The data will be transmitted in a serial fashion. The ground station will not be connected to the Internet, and shall be in communication only with the rocket. The data the GS receives from the rocket shall be stored, and used to update the visualization shown to the user.

## **2.2 Product Functions: The software shall provide several features**

- 1) The data shall be collected and stored for later use.
- 2) The data shall be displayed to the user in near real time.
- 3) The data can be used later to create a 3D trace of the flight path.

## **2.3 User Characteristics**

The GS shall be used only by people associated with this challenge, and thus have some level of technical knowledge. The visualization and 3D trace should, however, also easily readable by anyone.

## **2.4 Constraints**

- 1) Due to the altitude the rocket shall theoretically reach, there is a significant chance that packet loss and blackout could occur.
- 2) Due to the body of the rocket being in large part carbon fiber, there is a chance this could also cause packet loss.
- 3) The rocket has limited processing power.
- 4) The ground station will also not be very powerful.

## **2.5 Assumptions and Dependencies**

We assume the rocket shall be using a Telemega chip. We also assume that the GS will be based off of a Raspberry Pi, running a distortion of Linux.

## **2.6 Apportioning of Requirements**

There is a gantt chart in figure 1. This outlines the time line for our software from now until the test launch. Our software must be at a stable state by the test launch so it can be used to full effect at that time.

# **3 SPECIFIC REQUIREMENTS**

## **3.1 Protocol Requirements**

The protocol will be able, as long as there is a connection, to transmit a full set of telemetry data at least once per second. The packets shall also be packaged in a JSON or similar format.

## **3.2 GS Requirements**

The GS shall be able to display a visualization and update the visualization once per second.

## **3.3 Visualization Requirements**

The visualization will be human readable. This will be defined by at least 6 out of 10 people asked to review the visualization agreeing. These people will not be EECS majors, nor in similar fields. There will be an update once per second. This will make the visualization near real time.

### **3.4 3D Trace Requirements**

The trace shall be able to read the recorded data after the flight and display the flight path in 3D space.

### **3.5 Near Real Time 3D Trace (Stretch Goal)**

The trace can display the flight path in near real time as the data is received on the GS.

### **3.6 KATE Integration (Stretch Goal)**

We shall integrate KATE into our GS.