Group #9
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System Requirements

Name	Client Requirement	Engineering Requirements	Testing Process
01. Avionics Power Duration	The launch vehicle will be capable of being in launch configuration for 2 hours and everything will still work.	The internal batteries must be able to power the avionics system for at least 5 hours continuously.	1.) Begin with battery disconnected from avionics telemetry unit. 2.) Connect battery to avionics telemetry unit and start measuring time. 3.) Check ground station output to see if transmission is operational. 4.) Leave avionics telemetry unit operating for at least 5 hours. Pass Condition: The avionics system is functional, transmitting data, after five hours.
02. Tracking Location	An electronic tracking device will be installed in the launch vehicle and will transmit the position of the tethered vehicle or any independent section to a ground receiver.	The launch vehicle must accurately report its location within 10-feet range of its real location.	1.) Plug battery into the avionics telemetry unit. 2.) Ensure the ground station receives GPS data. 3.) Move to a geodetic survey marker. 4.) Record received GPS data. 5.) Compare known GPS

			coordinates from geodetic survey marker through the National Oceanic and Atmospheric Administration to the received GPS data. Pass Condition: The received GPS data is within 10 feet of the actual location of the device.
03. Data Transmission	Any rocket section or payload component which lands untethered to the launch vehicle will contain an active electronic tracking device.	The avionics system must transmit and receive data at a range of at least 1 mile.	1.) Set up ground station and plug in battery to the avionics telemetry unit. 2.) Have one person hold the avionics telemetry unit and start to walk away from the ground station. 3.) Walking person should walk away in a straight line, maintaining line-of-sight, to a known location that is 1 mile distance away from the ground station. 4.) At the ground station, continually check for data transmission. 5.) Confirm successful data transmission when the walking person has reached the 1 mile distance location. Pass Condition: If the data is

			still successfully transmitting.
04. Survive Launch Force	The team will design a system capable of being launched in a high power rocket and landing safely.	The avionics system must survive forces up to 10 g.	1.) Turn on and observe whether information packets are being received. 2.) Attach avionics system to avionics bay bulkhead. 3.) Place in vacuum chamber and ensure data is still being received. 4.) Turn on vacuum pumps. 5.) Wait for pressure to go below 0.86 atm 6.) Validate that data is still being received. 7.) Restore pressure to the chamber. 8.) Remove system from chamber. Pass Condition: The avionics system is still transmitting data when removed from the chamber.
05. Payload Power Duration	Teams may recover a sample from any of the recovery areas.	The payload must be able to move at least a quarter mile on one full charge.	1.) Charge the payload battery fully. 2.) Power on the payload with the battery. 3.) Set the payload on a long, flat surface. 4.) Drive the payload forward for a quarter mile. 5.) Check if the payload is

			still powered on. Pass Condition: The payload is still powered on after the travel of a quarter mile.
06. Sample Transport	The recovered sample must be stored and transported to at least 10 linear feet from the recovery area.	The payload must be able to collect at least 10 mL of solid material.	1.) Power on payload. 2.) Payload will be placed on a bed of plastic BBs. 3.) Ensure payload receives user input data. 4.) Control the collection system on payload to collect sample. 5.) Measure collected sample in a beaker. Pass Condition: The collected material measured in a beaker is greater than or equal to 10 mL.
07. Temperature	The launch vehicle will reach an altitude between 3500 and 5000 feet.	The avionics system must accurately transmit data at 32 degrees Fahrenheit.	1.) The avionics telemetry unit is powered. 2.) The avionics telemetry unit is placed in a freezer 3.) The ground station will be used to verify that data is being transmitted and received. 4.) The avionics telemetry unit will be kept in a freezer for half an hour or until it reaches 32 degrees

			Fahrenheit. 5.) The ground station will be checked during this time. Pass Condition: Condition is met if the avionic system is still accurately transmitting data to the ground station in the freezing environment for the entire duration.
08. Avionics GUI	The avionics will broadcast to the ground station and visually display data.	9 out 10 new users are able to identify the altitude, location, and acceleration data on the graphical user interface (GUI) during first use.	1.) Plug in battery to avionics telemetry unit. 2.) Connect ground station microcontroller to laptop that will run the GUI. 3.) Initialize GUI on the laptop, ensuring incoming data is being displayed. 4.) Start stopwatch timer. 5.) Survey student who has never seen the GUI is exposed to the GUI. 6.) Survey student is asked to identify what the altitude, location, and acceleration data are. 7.) Stop stopwatch timer. 8.) Repeat steps 4 through 7 for 9 more students. Pass Condition: 9 out of 10 non-ECE students with the

			GUI each identify altitude, location, and acceleration data on the avionics GUI in under 5 minutes.
09. Payload GUI	The payload system will visually display the location of the payload and the location of the designated sample areas.	9 out of 10 new users can accurately identify the rover and the sample area geographic locations on the GUI.	1.) Power on rover. 2.) Input the geodetic location as our sampling area. 3.) Initialize the GUI and start collecting GPS data from rover. 4.) Ask random users to inspect the GUI and identify the visual location of the rover and visual location of the geodetic location. Pass Condition: 9 out of 10 users should be able to identity which is the rover location and which is the geodetic location in their first use.
10. Accuracy Reliability	The electronic systems must be reliable.	Data packets sent must be accurate at least 90% of the time as compared to data received on board.	1.) The avionics telemetry unit will be powered on 2.) It should be separated from the ground station by at least 250 ft (the distance from the launch rail at the launch site) 3.) The avionics telemetry unit will start transmitting

			data packets wirelessly to the ground station when it is powered on 4.) The two systems will be allowed to run at this distance for an hour 5.) The ground station will continuously store received data packets in a CSV file. 6.) After an hour, the avionics telemetry will be powered down 7.) A script written by the team will compare the the ground station log and on board log for accuracy. Since the logs sequentially store each packet as a line of data, the script will be able to identify the ratio of matching packets to total packets sent. Pass Condition: The data packets received compared to the data packets stored on board are at least 90% similar.
11. Receive Reliability	The electronic systems must be reliable.	Data packets sent from the transmitter must be received at least 80% of the time by the receiver.	1.) The avionics telemetry unit will be powered on 2.) It should be separated from the ground station by at least 250 ft (the distance

			from the launch rail at the launch site) 3.) The avionics telemetry unit will start transmitting data packets wirelessly to the ground station when it is powered on 4.) The two systems will be allowed to run at this distance for an hour 5.) The ground station will continuously store received data packets in a CSV file. 6.) After an hour, the avionics telemetry will be powered down 7.) A script written by the team will compare the number of data packets in the ground station log and the number of data packets on board log for receiving rate. Pass Condition: 80% of the data packets are received by the target receiver.
12. Redundancy	There should be redundancy.	The flight data collected must be transmitted through wireless communication and stored internally on the launch vehicle at least once	Once the launch vehicle lands, we will recover the storage device for the flight data and analyze it for redundancy.

		a second.	1.) Power on telemetry unit 2.) Initialize Avionics GUI and start collecting data via the wireless communication device on the ground station 3.) Store the data received at the ground station 4.) Store the data sent within the storage unit of the telemetry unit 4.) Measure the receiving rate of data on the ground station Pass Condition: The flight data collected should be broadcast over RF, and stored internally on the launch vehicle. The data should be stored once a second.

Revision History

Date of Revision	Revision Description
Week 3 - 10/17/19	Document created.
Week 20 - 3/13/20	Update overall format to mirror contents of student portal requirements. Update requirements themselves.